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THE COLUMBIAN EXPOSITION FROM AN EUROPEAN STANDPOINT.

By J. Stephen Jeans.

IT will at once be conceded that the World's Fair at Chicago was by far the most extensive, and in many respects one of the most important events of its kind that has ever taken place in any country. It is a credit to the United States and a glory to the city of Chicago. It appears on the first blush almost a miracle that a community which was represented not more than half a century ago by a few log huts in the wilderness, and which little more than twenty years ago was devastated by one of the most destructive conflagrations of which we have any record, should in this year have been able to invite the whole world to assist at an exhibition of arts and industries which, whether regarded as a function or as a spectacle, is incomparably superior to anything that the Old World, with its centuries of civilization and resources, has ever produced.

For such an achievement as this, Europe has nothing to offer but approval, which has been freely bestowed. England has not been behindhand in her admiration of the wonderful virility and enterprise of our "kin beyond sea." But London has been abashed, Paris has been eclipsed, and Vienna has been put completely in the shade, by what Chicago has done. The problem that now appears to be offered for solution is that of *cui bono?* To what end has this enormous expenditure been incurred—this almost superhuman effort put forth, this marshalling of the nations been effected? It is fine as a show no doubt, but what are its other recommendations? What, in particular, is the United States likely to gain by the

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palaces and towers of Jackson Park and the Midway Plaisance? Is this the beginning of the end, or shall we see still greater exhibitions in the future? Does Chicago now stand at the meeting of the two continents, and, in self-sufficient mood, extend the challenge to the world? Or shall we witness in the future still greater exhibitions, still more costly pageants, still more wonderful triumphs of resource and organization? These are among the questions that are being asked in the older countries of the world to-day.

I visited the World's Fair in June, for the purpose of looking into the exhibits of mining and metallurgy, and drawing up a report on these subjects for the British Iron Trade Association. I was prepared to find the exhibition strong in these departments, having regard to the wonderful progress that the United States has made during the last quarter of a century. Within that time, Europe has been left far behind in nearly all the industries that were formerly more or less special to the European continent, and particularly to England. The strides that have been made in some of the foundation industries over the period named have been truly phenomenal, and have formed, at first a matter of incredulity, then a subject of anxious inquiry, and finally an object of unceasing wonder and admiration to the rest of Europe. Between 1870 and 1890, to take one or two examples, the production of American pig-iron had advanced from less than a third of that of Great Britain to about 20 per cent. more than that of the parent country. In others words, the American development in the interval is represented by 270 per cent., while the British development has not exceeded 31 per cent., and that of Germany has been about 200 per cent. As with pig-iron so with other forms of iron and steel, which it is employed to produce. The American output of Bessemer steel got ahead of that of Great Britain more than ten years ago, and is now almost twice as great as that of the old country. In many different branches of the manufactured-iron trade, in the crucible-steel industry, in the output of iron ores, and in many other subsidiary and collateral directions, the United States has long since gone more or less ahead of every European country. Other minerals and metals have fallen into the same line as iron and steel. The United States is to-day the chief producer of copper, lead, silver, and other important metallic products, which were formerly produced on a larger relative scale in the older countries of Europe, and more especially in England. This striking progress, founded on natural resources of an unrivalled character, has been

built up, promoted, and consolidated by a high order of intelligence and capacity in manufacturing industry, which has again challenged the admiration of Europe, and has compelled that imitation which is so sincere a form of flattery. American engineers now lead the world as mining experts, as is almost inevitable from the wider range of their observation and experience, and the much greater variety of conditions that they have to meet. American metallurgists have long ago compelled their congeners in England to own that they were not only original, resourceful, and enterprising, but that their methods were often superior, and their results so marvelous that they have not unfrequently been received with incredulity. In short, American mining and metallurgy now leads the world, alike in extent of production and in the technical skill and capacity at their command. Under these circumstances, I was naturally prepared to find that Chicago would bring to the front the most convincing and complete evidence of what has been achieved by the United States in both directions.

My disappointment may be imagined when I found that most of the principal American firms were not represented at the exhibition at all. Even the Illinois Steel Company, the greatest corporation of its kind in the world, although located at the very doors of the exhibition, was conspicuous by its absence. The Carnegie Company, which is another organization of which Americans have just cause to be proud, which is a monument to the organizing powers of my friend Mr. Carnegie, and which, as constituted to-day, has no counterpart in the old world, was also *non est* at Chicago. And so with many of the other leading manufacturing firms, whether individuals or corporations. When I was in Pittsburgh in 1890, I visited a small local exhibition there which was, probably, on the whole, more representative of American mining and metallurgy, apart from the precious metals, than the World's Fair of 1893, and I believe that if Pittsburgh were to put forth its full strength it could any day make a much better show than that made in this section by the United States as a whole at Chicago. In short, American metallurgy, except in one or two particular cases, can hardly be said to have been represented at Chicago at all. What one might reasonably have expected to find there was not there—such as models of special furnaces and plant, diagrams illustrative of the results obtained in working different processes, collective exhibits of the principal iron and steel manufacturing districts, shown in the form of trophies or

otherwise, and similar evidence of that progress which has so visibly compelled European ideas and methods to take a subordinate place, and led Lytton, in his "Coming Race," to declare that he preferred to talk lightly and indulgently of the ancient and decaying institutions of Europe, in order that he might expatiate on the achievements of that wonderful country on the other side of the Atlantic, in which Europe grievously seeks her model and tremblingly foresees her doom.

But while the exhibition was disappointing from a metallurgical point of view, taking a purely quantitative aspect, it was a focus of most of the great mechanical advances of the period that has elapsed since the Centennial at Philadelphia. In the intervening seventeen years the mining industry has grown from a bantling to a giant, the electrical industry has virtually been created, the metallurgical industry has been revolutionized as regards its *situs*, its methods, and its economic conditions, the business of transportation has undergone a marvelous development in reference alike to its dimensions and its cost, mechanical invention has cheapened methods and processes of production all along the line, the United States has taken the first rank in reference to the *technique* of engineering science, and now exports competent engineers as a regular article of commerce, while the country as a whole has witnessed a progress that is without precedent or parallel.

The Chicago exhibition may be approached from its technical as from its commercial side, but it is practically impossible, within the limits of a magazine article, to consider it from both. Or it may be regarded from the point of view of European countries, as exporters to the United States, or from the point of view of the United States, as a country that is aiming at securing a larger share of the business of the rest of the world.

The technical aspects of the World's Fair have already been dealt with at considerable length in publications devoted to the special arts and industries that were represented in the principal sections of the exhibition. Notwithstanding certain important omissions and shortcomings, it is not too much to say that a finer collection of exhibits representative of the applied sciences has never probably been got together. The buildings devoted to the mechanic arts, to mining, to transportation, to electricity, and to manufacture, were a compendium of the world's progress in each branch of those far-reaching subjects. As might have been expected from the country which produced Franklin, Wheatstone,

Morse, and Edison, the show of electrical appliances and systems, although limited to comparatively few firms, was remarkably comprehensive, and covered practically every recent advance in electrical science, so that the rest of the world had only to go and see in order to be satisfied, like the Queen of Sheba when she viewed the treasures of Solomon, that the half had not been told. The hall of mechanic arts was alike preëminent in motive power and machinery, and the numerous special papers by experts on both subjects have exhibited in great detail the strides that have been made in these directions since the Centennial of 1876, and the fertility of resource that is so specially characteristic of American engineers and mechanicians. Nothing more wonderful or more complete could well be imagined than the contents of the transportation building, and, as was to be expected of a country that has a railway system equal to that of the whole of Europe and the finest system of internal waterways in existence, the United States has no difficulty in giving points to the rest of the world in reference to both land and water communication. No such opportunity has ever before been afforded to railway engineers and managers of studying on the spot, and under the most favorable conditions, the special circumstances of that greatest of the world's great industries. Nor is it too much to say that there was not a little to learn. European railway engineers have more or less got into a stereotyped rut. They have come to regard their own methods and arrangements as sufficient for all practical requirements, and do not, as a rule, greatly concern themselves about what is going on in other countries. This is more especially true of Great Britain, which, in this, as in most other things of a kindred character, has got insular habits, rooted prejudices, or conservative instincts, standing in the way of progressive movement. I cannot do better than quote, as a case in point, the reply that the late Sir George Findlay, the able and genial general manager of the London and Northwestern railway—the most important line in Europe, as regards capital, cost, and traffic—made to a question that I put to him, in cross-examination, when he was a witness on behalf of that company before the special tribunal appointed by the Board of Trade some years ago to inquire into the subject of rates and charges on British railways.

"Do you know," I asked, "much about the transportation charges and conditions of working on American railways?"

"I cannot say that I do," was the reply. "I have not made them a subject of study."

This answer, which is on record in the printed minutes of the proceedings at the inquiry, will be regarded with surprise, if not with amazement, by leading railway authorities in the United States; but it represents what is probably a typical condition of thought and knowledge in Great Britain. The truth is that English engineers study American railway problems much as a naturalist might study the phenomenon of the fly in amber—not with any idea of applying American experience to their own circumstances, but as a curiosity, if not as a monstrosity, in its own special way. I am not now arguing, nor concerned to argue, whether this habit of thought is natural or proper, nor do I wish to claim that American practice could be effectually transplanted on English soil. I only state the fact as a fact, and I must leave it to another occasion to enter into the question of how far it is justified by the differences of condition and circumstance as between the two countries. Nevertheless, the Americans have compelled English and Continental railways to copy their methods and devices up to a certain point—as, for example, in the Westinghouse brake, the Pullman car, the mechanical coupler, the bogey truck, and other essentially American ideas and appliances. The transportation exhibits at the World's Fair may be expected to suggest and ultimately to bring about other departures from established European practice, on distinctively American lines, but if it should not happen thus, it certainly will not be from any lack of new ideas in railway plant and working, on the part of American roads.

Finally, I cannot fail to make mention of the vast structure devoted to manufactures—the largest building of its kind, and probably of any kind, that has been erected in the world's history, and one which, if it had stood alone, would have made the Chicago exhibition a memorable event. I am not about to enter into elaborate statistics, as some of the guide-books and newspapers have done, with a view to magnify the superlative dimensions of this structure, nor do I propose to even glance at its strikingly varied, handsome, and suggestive contents. With regard to the former I would only say, as indicating the gigantic character of the enterprise, and the comparatively greater ease with which such matters appear to be managed in America, that this one structure cost almost as much as the Imperial Institute of London, a structure that has been reared by the British empire as a whole, to commemorate the reign of Queen Victoria, under the direct personal guidance of the Prince of Wales, and justly regarded as one of

the greatest glories of that reign, considered merely as a piece of architecture. But the Chicago exhibition could boast of many such structures, not of course so large nor so costly, but not less beautiful and not less worthy the attention of mankind as regards their architecture, their arrangement, and their contents. I would not, again, venture to either describe or criticise the contents of the Manufactures building, beyond the remark that amid much that is beautiful, interesting, and new, the arts and industries of Japan command the attention of the most casual observer. A glance at the catalogue will show that the Japanese had a numerically larger exhibit in the Manufactures building than any other nation, not excepting even the United States, and this is a circumstance that must be pregnant with meaning and fraught with issues of importance, as regards the future, and one which for that reason European nations cannot afford to disregard. Japan is one of the most enterprising and progressive of Asiatic countries, and one, moreover, that the United States, both by geographical position and adventitious circumstances, has come to regard as a natural market. The trade between the two countries has enormously increased during late years. Since 1878, the imports of Japanese goods into the United States have more than trebled in value, while the exports from the United States to Japan have increased by about 50 per cent. The complete capture of the Japanese market by American manufactures may be finally accomplished under a modified tariff and a rigid adherence to the principle of give and take, and the present display at Chicago is likely to effect a good deal in this direction. So also, in a more or less modified degree, with the markets of South and Central America. Of late years the United States has made greater inroads upon these markets than any other country. Since 1878, the American exports to Mexico, Brazil, and Chili have fully doubled in amount, while those to the States of Central America have more than doubled, and the extent of the trade in both directions is increasing every day. This is not by any means a spasmodic or accidental movement, but one which is steadily growing in strength and volume, and is likely to make still greater headway when the Nicaraguan canal has been completed.

Another feature of the Chicago exhibition that marked it as a thing *sui generis*, and imparted to it a distinctly American character, was the immensity of its component parts as well as of its *tout ensemble*. This feature was apparent throughout the whole exhibi-

tion, from the largest building on the ground to almost the smallest essential detail. The motive power was a striking case in point. At the Centennial exhibition the great Corliss engine, which developed about 1400 horse power, and was regarded as the greatest mechanical wonder of its day, furnished practically the whole of the motive power required for Machinery Hall. But at the Chicago exhibition not less than 24,000 horse power were employed, of which nearly one-third was used for driving exhibits of machinery. The increase of power was not more remarkable than the increase in quality. Superfluous bulk had been got rid of, and the Columbian Exposition of 1893 was, as a rule, a much more perfect machine, alike as regards power, cost, mechanism, and economy than its predecessor of 1876. Then, again, we had at the Columbian the largest guns, the largest armor-plate, the largest hammer, the largest dynamo, the largest search-light, the largest landing-stage, the largest lake or river steamer, the largest locomotive, and not a few other things besides. This characteristic of the exhibition is likely to make a new point of departure in the history of each and all of these objects, while it will not be forgotten that the World's Fair has synchronized with the construction of the largest Atlantic liners in the old world, and the commencement of the largest Atlantic liners heretofore attempted in the new. More power and size, but especially more power in relation to size, appears to be the demand on both continents, and that demand the people of the United States have so far, and especially in their display at Chicago, shown themselves fully competent to meet. All this opens up a wide and long vista of possibilities, which the discerning and judicious will not fail to take account of. The Pharaohs who built the pyramids and the imperial Romans whose works are still a source of lasting wonder, are already left behind. What surprises and achievements has the future yet in store?

From an European point of view, it need hardly be said that one of the principal, if not absolutely the chief, considerations that have been present to the minds of intending or possible exhibitors has been this,—how far it would be possible to bring about an increase of business by being represented at Chicago. The day has almost gone past when important business firms have cared to make a great display at any exhibition for the sake of mere honor and glory. The utilitarian is now the principal standpoint assumed by manufacturers and merchants, and especially so in times like these, when profits have to be cut very fine, and when the margin

available to "play with" is so very small. British manufacturers, it must be confessed, have not seen their way to a due return by showing at Chicago, taken as a body, and hence the majority of the largest firms have not been represented at all, notwithstanding the efforts made by my friend Mr. James Dredge, in papers read before the Society of Arts and elsewhere, and by my friend, Mr. H. S. Caine, M. P., in a paper submitted to the British Iron Trade Association, to induce an adequate muster. Stony indifference, or keen resentment of hostile tariff legislation, has kept British manufacturers aloof.

There is no gainsaying the fact that the McKinley Tariff act struck a great blow at the commercial relations of the United States and Great Britain. Its avowed object was to secure American markets for American manufacturers, and as a consequence to dispossess British manufacturers who were already in possession. That object has only partly been attained. The damage which the act has inflicted on British trade interests is not nearly so great as was at one time anticipated. Even the tin-plate industry of South Wales continues to survive, and even to flourish. But the intent and tendency of American tariff legislation were none the less apparent, and both being unfriendly to British interests, the typical Britisher made up his mind to leave Brother Jonathan and his exhibition severely alone. It does not appear as if the exhibition had suffered greatly in consequence, and if any suffering should follow this probably most natural action, it may easily fall on the British industrial himself. At any rate the imports of European produce into American markets are still large and increasing, as the following figures show:

IMPORTS INTO THE UNITED STATES FROM EUROPE.

	1878.	1892.
Austria-Hungary	$ 272,000	$ 7,718,000
Belgium	3,982,000	10,273,000
France	43,378,000	68,554,000
Germany	34,790,000	82,907,000
Italy	6,711,000	22,161,000
Netherlands	2,774,000	10,886,000
Portugal	429,000	1,966,000
Russia (in Europe)	600,000	4,926,000
Spain	3,265,000	5,207,000
Sweden and Norway	137,000	3,754,000
United Kingdom	107,290,000	156,300,000
Totals	$203,648,000	$374,652,000

Here we find that there was a proportionately smaller advance in the imports of British produce into American markets, as between these two years, than in that of any other European country, and that while the mother country furnished over 50 per cent. of the total American imports from European countries in 1878, she only contributed about 43 per cent. in 1892. In the interval, the progress made by Germany, France, Belgium, and Italy has been very striking indeed, and proves conclusively that in those countries England has watchful and determined competitors. The success of that competition will probably be even more marked in the future than it has been in the past, all the more so if England allows her rivals to so far excel her in the impression made on possible buyers of her wares as she has done at Chicago, where Germany has gone far ahead of her in iron, steel, chemicals, and ordnance; where France takes an unquestionable lead in *articles de luxe;* and where the manufacturers of Belgium have made good their claim to be regarded as serious competitors.

Until now, the United States has done comparatively little in the way of exporting manufactures, but the last few years have witnessed an expansion of the means of production in most branches of industry that is far ahead of the home demands, and have compelled manufacturers to seek for markets abroad. Dear labor and other well-known causes have hitherto hindered progress in this direction, but the progress has, nevertheless, been real, if not rapid, and American locomotives, cars, machines, and tools, may now be found in most civilized countries. The advance in the export trade made since 1878 is thus shown:

EXPORTS FROM THE UNITED STATES TO EUROPE.

	1878.	1892.
Austria-Hungary	$ 2,831,000	$ 1,527,000
Belgium	23,537,000	48,785,000
France	55,319,000	99,126,000
Germany	54,809,000	105,521,000
Italy	8,741,000	14,317,000
Netherlands	13,300,000	43,917,000
Portugal	4,011,000	4,091,000
Russia (in Europe)	11,002,000	6,698,000
Spain	8,205,000	11,528,000
Sweden and Norway	2,807,000	6,579,000
United Kingdom	387,430,000	499,315,000
Totals	$571,992,000	$831,404,000

Whatever purpose the European exhibitors at Chicago might have in view, there can hardly be a doubt that the American exhibitors were there for business. "*Le véritable genie de notre époque*," said M. Thiers on a memorable occasion, "*consiste dans le simple bon sens.*" This remark is especially true of the practical and hard-headed American people, who do not allow much sentiment or shadow-hunting to stand in the way of their realization of practical ends. Whatever, therefore, may be the issue of the Columbian Exposition, from an European point of view, there cannot be a doubt that it has afforded to American manufacturers a grand opportunity for extending their trade relations with the rest of mankind, and one which is likely to bear more or less fruit in the time to come, according as the economic circumstances of the country are adapted to cheap or to dear production. If I might be permitted for one instant to tread on polemical ground, I would add that in my own opinion American manufacturers have everything to hope from the repeal of the tariff, and, in their present advanced circumstances, very little, if anything, to gain by its continuance.

CAUSES OF FAILURE IN "BOOM" TOWNS.

By H. S. Fleming.

BETWEEN 1884 and 1889, in the United States, a vast amount of experience was gained by those who sought to acquire sudden fortunes through speculations in "boom" towns, and as subsequent years have shown, they have in the majority of cases paid well for their knowledge. Those who were not financially interested in the great number of small towns which sprang into existence throughout the West and South during that period, may find instructive reading in the printed matter issued by some of the companies, but the unfortunate ones who held on and are still "interested" will, in view of the present situation, find in such studies a lesson on the value of facts and common sense as they relate to business ventures in general, and to "boom" towns in particular.

What we know as "booms" are no new thing. No less a personage than General Jackson was, in the early part of this century, a leading figure in "booming" the little town of Florence, Alabama, and, if accounts of that time can be relied upon, this frontier post, surrounded by a wilderness, with no neighbors but Indians and with no means of transportation other than the long trip down the Tennessee river to the Ohio, was so aroused that the price of lots was higher than it has ever been since. Early in the "thirties," according to Judge Cooley's history of Michigan, a "boom" of magnificent proportions spread throughout the timber region of that State, inflating values to preposterous figures, and finally collapsing. In the latter part of the same decade the construction of the James river and Kanawha canal, in Virginia, gave rise to a similar "boom." Along the line of the canal land values rose to impossible figures, and it was freely predicted that Lynchburg would within a short time outgrow New York in both population and commerce. During nearly every decade there have been "booms" in different parts of the United States, more or less local in nature. There have been the gold fever, the petroleum excitement, and the natural-gas craze, but about 1884 a general "boom" seemed to take place throughout the country, its effects showing more clearly in the less developed States of the South and the Northwest.

In each section the "boom" has had some distinctive features which, successfully carried out in one town, were immediately adopted in others. Throughout the East, suburban development assumed the general features of a "boom," though of course the East was too dignified to allow such a term to be applied to it. In the region around Kansas City, in the West, railroad developments and agricultural possibilities were the main features; at Wichita, Kansas, which experienced the greatest and most disastrous of all modern "boom" failures, railroads and the ultimate opening of the rich agricultural lands of Indian Territory; in the Northwest, railroads and wheat farms; in Washington and Oregon, timber resources and natural harbors; in California and some other States, fruit-growing and irrigation, the latter especially taking a strong hold in the West; finally, in the South, mineral resources were the basis, with the exception of a short though none the less active flurry over Florida orange-lands.

Referring more particularly to the "boom" in the South, with which section the writer is most familiar, it is noticeable that apart from the excitement in Florida orange property, which was purely local in character, there was no inflation of any kind in the agricultural regions or in the larger and well-established cities. On the contrary, there was a natural growth which, it is only fair to say, has been even greater since the collapse of the "boom" than during its most exciting days. Another matter which should be stated in justice to the South is that the vast majority of "boom" towns which were started were from their inception to the end the schemes of speculators from the North and, in the majority of cases, from New England, while the steady and permanent growth both during that time and since has been the work of Southern people or those who have cast their fortunes with the South.

In the mineral region the "boom," when once started, gathered headway with almost incredible rapidity,—new towns, furnaces, factories, and mines being started everywhere, while prices advanced at a rate which cannot be appreciated by any but those who were on the ground. Beyond question the town of Birmingham, Alabama, inaugurated the "boom" in the South. In 1870 some gentlemen connected with a railway then being built from Montgomery to Decatur, crossing the line of the Alabama and Chattanooga railroad in Jones Valley, near the town of Elyton, knowing of the extensive deposits of iron ore and coal in that vicinity, purchased some 4000 acres of land at $25 per acre, pay-

ing three-fourths in cash and the balance in stock of a company to be formed. The Elyton Land Company was then incorporated, with $200,000 capital, in shares of $100, one-half being paid in, and the lands already purchased transferred to it. Work was commenced in laying off streets and a few buildings were erected. In June, 1871, the first sale of lots was held and one of these, which was sold for $100, is still retained by the original purchaser and is valued in the neighborhood of $50,000. Up to 1879 the affairs of the company prospered but poorly. Its stock had been as low as $15 per share and debts of about $150,000 had accumulated against it, but during the latter year the erection of the Alice furnace was commenced and a few months later the works of the Birmingham Rolling Mill Company were under construction. From then until 1883 there was a rapid gain, the company's debts being cancelled, many improvements made on its property, and a dividend of 100 per cent. paid on its stock. From this time forward the success of the company reads more like a tale from "The Arabian Nights" than nineteenth-century business. During 1886 dividends amounting to 340 per cent. were paid, and in 1887 alone the dividends for that one year were over 20 hundred per cent. From 1883 to 1887 the total dividends paid amounted to nearly 30 hundred per cent. on the capital stock or about 60 hundred per cent. on the original investment, and besides these dividends the company had spent more than $1,000,000 in buying more real estate, erecting manufacturing plants and otherwise improving its property, and to-day has properties and franchises valued at several million dollars.

Naturally, with such an example before them, town "boomers" found a fertile field in which to work and put forth their efforts to duplicate the success of Birmingham. The strength of this town lay first in its mineral resources and secondly in its railroad facilities; consequently each new town that was started based its claim for future prosperity on the possession of these two features, usually claiming them to a preëminent degree, and for itself the feature of being the center of the universe and a spot where the cheapest iron on earth could be made. The *sine qua non* of a "boom" town was a blast-furnace, and unless it either had one or was going to without delay it could not expect to compete with towns which were making preparation for dozens of furnaces. Of course other branches of iron-manufacture were to follow, and then any industry that might be secured.

There was a feature about these "boom" towns which must be re-

ferred to with both shame and regret on the part of the engineering profession. In order to start a town the promoters had need for reports on the coal, iron-ore, and other resources of their property. In some cases the so-called "practical" man was employed for this work and usually lied in proportion to the amount he was paid. In most instances, however, engineers who were professedly honorable men made the examinations and, in the vast majority of cases, either deliberately misrepresented the facts, or were criminally misquoted in the published reports. Cases are known where, upon an honest statement of facts being submitted, the report was suppressed and other men employed who would not hesitate at dishonesty. That such a thing should have been permitted without any action on the part of the engineering societies has tended beyond doubt to lower the standard of the profession before all who have had any connection with these enterprises.

The usual method of starting a "boom" town was for the promoters to select the place to be operated upon and quietly secure options on as much land within it as possible, and large tracts around it. The interest and coöperation of capitalists was then secured and a company organized, stock being sold, and if necessary bonds issued, to provide money with which to take up these options and carry on the necessary improvements. This done, efforts were made to induce the owners of manufacturing plants to move them there, enterprises were organized by the stockholders and promoters, and attractive reading matter prepared to advertise the town and its resources, and what was to be done to insure its growth. So soon as things were in readiness a "first sale" of lots was advertised far and near, all kinds of inducements being offered to secure a large attendance. Excursions were organized to start from various cities, running through trains of sleeping-cars to the town, usually at reduced fares, and sometimes free. Such announcements naturally drew many people who hoped, from reports received from their friends or through the papers, to be able to buy a lot, part cash and the balance in a number of years, and sell at a profit before the first payment became due. Some few purchased with the intention of making the new town their home, but these were in the minority. As an instance, during the "boom" at Cardiff, Tenn., five train-loads of Pullman cars left Boston, reaching Cardiff in time for the sale, and in three days over $1,000,000 of property was sold. The town does not contain twenty people to-day.

As a rule these "first sales" were gambling ventures, pure and

simple. The lots had practically no intrinsic value, while their prospective value depended entirely upon the realization of promises made by the company. The transactions which took place at the beginning of the sale, usually in charge of an experienced auctioneer, were made to persons interested in the company for the purpose of establishing valuations in different parts of the embryo town. When the general public commenced to bid, if the prices showed any signs of declining, the promoters or their agents again came to the rescue. Tricks and subterfuges of all kinds were resorted to and promises of almost anything might be had of the promoters. In the excitement, manufacturing and other enterprises were "projected" at a moment's notice, and companies with millions of "capital stock" organized by a word. Business men who might be unduly conservative at home were completely carried away and would enter into the most improbable schemes in all seriousness of purpose, fully expecting to realize within a few days' time.

An interesting example of the "boom" town is Fort Payne (near Birmingham), Alabama, which was quite prominent at one time. This town is situated in a valley whose once fertile soil has become impoverished by the continual growth of one crop. On either side are hills and mountains, the mountain on the east containing at its top two thin seams of a poor quality of coal, while on the west side, in a range of low hills, is an equally thin seam of fossiliferous iron ore which, as it dips under the protecting cover of the country rock, becomes so impregnated with lime and low in iron that it is commercially valueless. A few small deposits of brown hematite are also found in these hills, but not in sufficient quantity or of a quality to be useful. Limestone is abundant near the town. Back on the mountain to the west, from ten to twenty miles distant, there is a fair supply of timber. The Alabama Great Southern railroad passes through the place, giving access to the south through Birmingham and to the north by way of Chattanooga. Certainly these resources do not appear to have been enough to warrant any great industrial establishments; yet promoters took hold of it, organized a company, and advertised it in glowing terms. According to the prospectus the officers of the company were all New England men of high standing. The company owned 32,000 acres of land, abounding in inexhaustible quantities of iron-ore, coal, kaolin, fire-clay, limestone, timber, and water. Three thousand acres of land adjoining the town were set aside as town-site lands. In the words of the prospectus of the Fort Payne Coal and Iron Company:

The company has laid the foundations broad and surrounded the enterprise with men whose financial skill and judgment are a guarantee that the inexhaustible resources of this fine property will be carefully and fully developed, and, as a natural result of such development, a city will rise in its midst. The lands of the company contain in illimitable quantities the two great staples, iron and coal, supplemented by vast forests of hardwood timber, combining in one plant and in juxtaposition all the elements of a manufacturing city.

Referring to the minerals the prospectus says:

First in importance among the mineral deposits of the lands owned by the company comes that of iron. The distinct veins of fossiliferous red hematite ore have been developed for a distance of twelve miles on the property; it is known to underlie some 23,000 acres of these lands. From numerous analyses and tests made this ore is found to run high in metallic iron, ranging from 35 to 60 per cent. in iron. By reference to the reports of experts in another part of this prospectus it will be seen that the ore is, to a large extent, self-fluxing,—a very desirable feature, requiring less limestone in the furnace and largely increasing the percentage of iron from the basis of cost. It is estimated that the two above-mentioned veins contain 200,000,000 tons of iron on this property alone.

But no mention is made of the report of a prominent engineer from New York city, who, after examining the entire property, condemned it as valueless for the purpose intended. A company was organized which erected a blast-furnace, operating it during the "boom" at an enormous loss, the iron produced costing in the neighborhood of $20 per ton. Another furnace was started but never completed. A railroad ten miles long was constructed to the top of the mountain to develop the coal-mine. One hundred coke-ovens were erected. A big steel-plant was partially completed. A large factory was built for hardware specialties, an extensive fire-brick and terra-cotta works was erected, and foundries, machine-shops, a basket factory, asphalt-block works, and other small industries started. Waterworks and electric-light plants were built, besides many cottages, stores, office buildings, banks, hotels, and schools. Half a mile from the center of the town lots sold for $10 a front foot, and in the business part sales were made for $250 or more. They are now worth practically nothing. The resources were myths. Those who invested took the shadow for the substance and have suffered from their lack of judgment.

While this is only one of many such towns, it must not be supposed that all of the places "boomed" had such slender foundations upon which to stand. In one sense the exact reverse is the case. Not that the actual resources were so great as each claimed, but there were few cases in which some real merit did not exist, and, had the promoters been willing to go to work upon a legiti-

mate basis, great good would have resulted where there is now ruin. For instance, Middlesborough, in eastern Kentucky, is in the heart of a fine coal region, and has near it extensive forests of valuable woods. The development of these would have resulted in a town of fair size and undoubted prosperity, but to build there such a city as was anticipated by its misguided stockholders, was an absurdity which no unbiased mind can view with anything but pity. The town in which thousands, even millions, of dollars were spent, is now almost deserted, and would be entirely so were it not for the coal mines and some woodworking establishments. Another such instance may be found in the town of Tallapoosa, Georgia, which was the scene of one of the most extensive and rascally frauds ever perpetrated in the South; another in Cardiff, Tennessee, which was conceived by people interested in Fort Payne; still another in Sheffield, Alabama, and its sister town across the river, Florence, once the seat of General Jackson's efforts, boomed this time by Philadelphia people. But the list is too long to be given here.

The reason why these places have failed to succeed according to their expectations will be apparent after a moment's consideration of the conditions necessary for the growth of any town. Basing its prosperity upon its possibilities as a manufacturing center and granting that it possesses all the resources and railroad facilities necessary for such purpose, it must secure the establishment of various manufacturing enterprises. These will need many employés who will buy provisions, household goods, clothing, and the various necessaries of life from stores. In this way the basis for mercantile business is established. To carry on the business banks are necessary for convenience and safety in handling money; thus the financial end is founded. The employés of the manufactories, mercantile houses, banks, and other branches of business will need houses to live in, and these must be erected upon land which, necessarily, is purchased from the town company.

Assuming that each manufacturing plant is on a sound financial basis, running full time and employing steadily its quota of mechanics, laborers, and clerks, producing goods below the selling price and finding a ready market for its entire output, then money will come to the town through these sales, be distributed through employés to the stores, and sent away through the banks in payment for merchandise purchased. Part of the money goes for rent or in payment for homes, and, as these are built on the land company's property, they consequently secure an income from it, both

from homes and business houses. As manufactories increase in number and size, so does the volume of business ; consequently a business man can afford to pay a higher price for land upon which to erect a store. So also the clerk or laborer can pay more for his home, since with money circulating freely their wages are good and the continuance of such wages assured. Thus values increase in proportion to the advance in the volume of trade, in a manner perfectly legitimate and upon the solid foundation of prosperous commercial intercourse with other places.

This is the *theory* of " boom " towns, but it is too nearly elysian to be found in practice. In the first place the enterprises secured were not always adapted to the particular resources of the place. Those which were not had but small chance of succeeding, while both these and those which were so suited, were, almost invariably, started on such an extensive scale and so hampered with enormous capitalization, bonds, mortgages, and debts, that in a financial sense alone their continuance was doubtful. Added to this was the fact that each was in a new territory and had to contend with many troubles, such as securing the necessary amount and proper kind of labor, arranging for a steady supply of raw material, and finding a market for the product. These details cannot be overcome in a day,—it takes years to perfect them. Manufacturing plants moving from Northern cities, as a great number did, located in the new towns more because of the inducements offered than on account of the resources, and few of them could retain the business of their old customers, but had to seek new markets. Another trouble was that, as a rule, all of the money subscribed to or invested in the new plant was expended in salaries, buildings, and machinery, so that when completed and in readiness to operate there was none left with which to purchase material or run the plant, to say nothing about sending out men to introduce the goods. As a natural result, when the construction of various works was completed, there was no further employment for the laboring classes and mechanics, and the distribution of money through them ceased. This immediately affected the merchant, and, through him, the banks. Property became less valuable because stores could not pay high premiums for land while doing a small business, and the mechanic and clerk were either thrown out of work or received smaller pay, and as a result were unable to purchase or rent a home for such a price as before. The land company's property consequently depreciated in value.

There is a logical sequence in the rise and fall of a "boom" town which, while interesting to watch from an entirely disinterested standpoint, has brought disaster to many a would-be speculator who laid down his money, earned and saved in years of hard work, with the hope of being able to make enough in one or two transactions to give him a competence for life. The secret of the failure of "boom" towns lies in the fact that the promoters and investors discounted the future while deliberately closing their eyes to the present. They disregarded the most common rules of business with a persistence and blind obstinacy truly marvelous. Never stopping to reason they plunged into a sea strewn with half-covered reefs of financial ruin and allowed the wind of excitement and enthusiasm to blow them about at will, and when they finally struck a rock and were wrecked, they blamed not themselves, their greed, or their blind impetuosity, but the town, its over-estimated resources, and everything else which failed to meet their hopes, forgetting that the facts were before them all the time.

It is safe to assert that 90 per cent. of the towns "boomed" in the southern States, which are now failures, would now be in a healthy and prosperous condition had they been started and carried on in the manner usual in business enterprises. As it is, the collapse of the "boom," together with the past three years of financial depression, has dealt them a serious blow from which they have been slow to recover. A movement for the better started some time ago, but it has been slow, very quiet, and very earnest. Big factories and works have changed hands, the new owners securing them for a small part of the original cost and starting with a limited force, producing only so much as can readily and profitably be disposed of. This movement is general and is the precursor of a substantial industrial growth which will soon be beyond the reach of "booms" or any other undue inflation of values.

The lesson of the "boom" will never be lost to those who were engaged in it, but no amount of preaching will prevent the repetition elsewhere of this state of affairs. There are still many persons who believe themselves wiser than all the rest of mankind, and when a "boom" starts in some part of the country, as will probably be the case within the next one or two years, there will be found plenty to go into it with money and hopes, to come out only with experience and debts.

THE IRON-ORE REGION OF LAKE SUPERIOR. II.

By Richard A. Parker, C. E.

THE GOGEBIC RANGE.

IN 1883, rumors of the occurrence of soft red hematite near the western boundary of the Upper Peninsula, following the trend of the old Marquette range, were current upon both the Marquette and the Menominee ranges. A few men from the iron mines, with their "outfit" of flour, bacon, kettle and pick, worked their way westward over the trail leading to the Indian reservation near Ashland, Wisconsin. Finding signs of ore, they prospected and were rewarded by the discovery of ore beneath the roots of a tree upon a hill, south of the present site of Bessemer, Michigan. This proved to be the wonderful Colby property, which made such a record for rapid development and yield from the day of its discovery, and which is to-day in position to make an annual output of 300,000 long tons, or over. Shortly after the discovery of this mine, Mr. A. Lanfear Norrie, of New York city, took an "option" for a lease upon lands owned by a large land corporation, and his men found the mine which proved to be one of the largest underground producers of iron-ore this country has known. This property he subsequently leased to the Metropolitan Land and Iron Company, at a slightly advanced royalty over that paid by him to the land company. In the meantime, the Milwaukee, Lake Shore and Western railway, having its terminus in the pine woods, and operating largely as a carrier of pine logs, surveyed a route to the mines and on to Ashland, Wisconsin, a distance of about forty-five miles from the mines, where a lake port and dockage room were available. In 1884 the first shipment was made from the Colby mine of one cargo of 1022 tons of ore. By the end of 1885 there were eight producing and shipping mines, whose total output was 119,860 long tons. In 1886 thirteen more names were added to the list of shippers and the total of 747,589 tons was reached. From that time on the district has maintained a steady growth and held its position, so quickly assumed, of second in importance of amount of ore shipped annually; but in 1892, with a

maximum shipment of 2,973,993 long tons, it stepped to the front rank of Lake Superior iron producing ranges. The largest annual output from any one range was made by the Marquette range in 1890, when it shipped about 20,000 long tons more than the maximum Gogebic range output. Since the opening of the range in 1884 up to the close of 1892 the Gogebic range has sent to market 13,260,206 long tons of ore, all of which was soft hematite.

Much excitement attended the birth of this range, of which advantage was taken by unscrupulous schemers to fleece the unwary. Trenches a few feet deep and wide, run in a body of jasper that contained enough hematite to color the surface water red, were inspected by the tenderfeet, who were easily led to believe the fabulous stories set afloat by the manipulators. Options for a lease were put into stock companies—leases, of course, being the more usual mode of procedure in the stock gambling. Forty thousand shares were usually issued at a par value of $25 each; and $4, $5, and $6 per share was not an unusual price for one of these jaspery options. Red water, of course to the uninitiated, meant ore, and that meant the doubling of the prices of stock. In several instances the entire issue of 40,000 shares of stock was sold—the proceeds going to the vendors, leaving the company without treasury funds of money or stock with which to carry on mining operations. However, the reaction came in due time, the properties passed into the hands of iron-ore men of experience, and the range has emerged from its infantile diseases, a strong, healthy child of Michigan.

The ore lies in a V-shaped trough which has usually a pitch or slant to the east; the left leg of the V being usually the quartzite footwall. Sometimes it is a dense, impermeable wall of jasper lying north of the persistent quartzite from 30 to 60 feet; the left leg is a more or less decomposed, intrusive diorite sheet; while over the ore-body, in a more or less rounded cross-section, is the banded jasper schist of the range, and from which, by leaching, alteration and concentration, the ore has been derived. While there is usually but one footwall, there may be several dykes, one underlying the other, upon which ore is very frequently found. These dykes also tend to split into two or more, each carrying its varying amount of ore. They are quite continuous in the direction of the trend of the range, and have been known to extend for over two miles.

The usual method of removing ore is by the use of heavy sets

of timbers two to three feet in diameter, framed to form the skeleton of a cube, usually 7 feet 4 inches from center to center. These square sets or frames reach from one side of the deposit to the other, and from the floor of the level up to the roof or floor of the overlying level. They offer a means whereby the ore can be attacked and removed, at the same time temporarily supporting the roof. At intervals pillars of ore are left to support and keep the roof from caving unexpectedly. These pillars are afterwards removed by cutting into the center of the pillar at right angles to its length, then driving a drift in the direction of its main axis to the hanging wall; the ore close to this wall is then removed and its place taken by timber. This continues until the wall gives signs of weakening and the timbers show that the great weight of rock is bearing upon them. At times, a post 2½ feet thick is crushed and mashed upon itself, and caps are squeezed into one-third or one-fourth of their original diameter. When this pressure evidences itself, the ore in the pillar and near the rock is lagged up; that is, poles 4 to 6 inches in diameter are laid closely together to exclude rock or sand, and work at this pillar is temporarily stopped until the hanging wall has crushed the timbers and fallen in. The miners then attack once more the ore in the pillar, and draw back or away from the barren wall of rock until it is again time to vacate. The result of such a system of caving is to wreck the surface; it follows down as the ore from the several levels is removed, until, as one now stands and views the chasm made by man, it cannot but give him the feeling that it is exceedingly unsafe to be underground, while the fact is, that the mine is in an exceptionally safe working condition, and a very high percentage of the original body of ore is obtained in this way.

The product of this entire range is a soft hematite averaging 62.5 per cent of metallic iron—some of the properties shipping for an entire season ore that will run 1 per cent. above this average. The greater portion of the output is ore that is very low in its phosphorus content, so that it is available for steel making by the Bessemer process. This is true to a remarkable extent, considering the great output of the range. None of the other ranges are fortunate enough to possess the same quantity of this grade of ore, though each has its quota.

The total shipment of ore from the Gogebic range, up to the end of 1892, has been 13,260,206 long tons, or an average of 1,473,356 tons for each year it has had shipping facilities.

THE VERMILION RANGE.

SIMULTANEOUS with the opening of the Gogebic range in Michigan and Wisconsin, the Vermilion range of Minnesota heralded the news of its valuable possession of ore deposits, and made its first shipment of 62,124 tons of ore the same year (1884) that the Gogebic range made its initial shipment.

In 1875, explorations were in progress near Tower, Minnesota, and by trenching across the ore-bearing rocks, the main seam of ore, which ultimately proved to be that now operated by the Minnesota Iron Company, was found by a party exploring under the direction of Mr. Stuntz, of Duluth, Minnesota. Trenches had been cut in numerous places, and one showed a seam of clean hematite thirteen feet wide that was very hard, and, with the tools and black powder then available, almost impossible to test and break. However, a mass of ore weighing nearly 60 tons was broken off and sledged with hammers until the face of clean ore was exposed, which ran 67 per cent. in metallic iron. Five years afterwards, systematic explorations were again resumed by Mr. C. Tower and Mr. Munson of Utica, New York. This year, the explorations were in charge of Professor Chester of Hamilton College, New York, and were confined to what is locally known as the Soudan bluff, but he evidently failed to find satisfactory evidences of ore, for athough supplied with provisions for three months, work was stopped about September 1. The next year work was again resumed, and a large deposit, having a width of 25 feet was developed. Numerous trenches were cut, as sinking on the ore could not be followed long on account of the difficulty of handling the incoming water. Black magnetite had been found on the Tower bluff, in a belt of jasper, but it carried too much sulphur near the surface to warrant its being developed further. Work was then prosecuted east of this belt of jasper and the seam just referred to opened up. This is the property now operated by the Minnesota Company and for which, together with the Chandler, Zenith, and other mines, the one hundred miles of railroad and large docks at Two Harbors were built.

In the southeast corner of section 28, town 63 north, range 12 west, is located the Chandler mine, a soft-ore deposit which has achieved a great reputation on account of the amount of high grade ore produced annually. It is second in output only to the Nomi mine upon the Gogebic range, while its average grade is somewhat better. The advisability of pumping out Shagawa lake, lying north of the

EXPLORING CAMP ON GOGEBIC RANGE IN 1886.

mine, has been discussed, in order to reach the ore believed to lie below it; but, owing to the volume of water to be removed, and the element of uncertainty still remaining as to whether the work of this nature undertaken at Ishpeming, Mich., will prove successful or not, nothing has as yet been done.

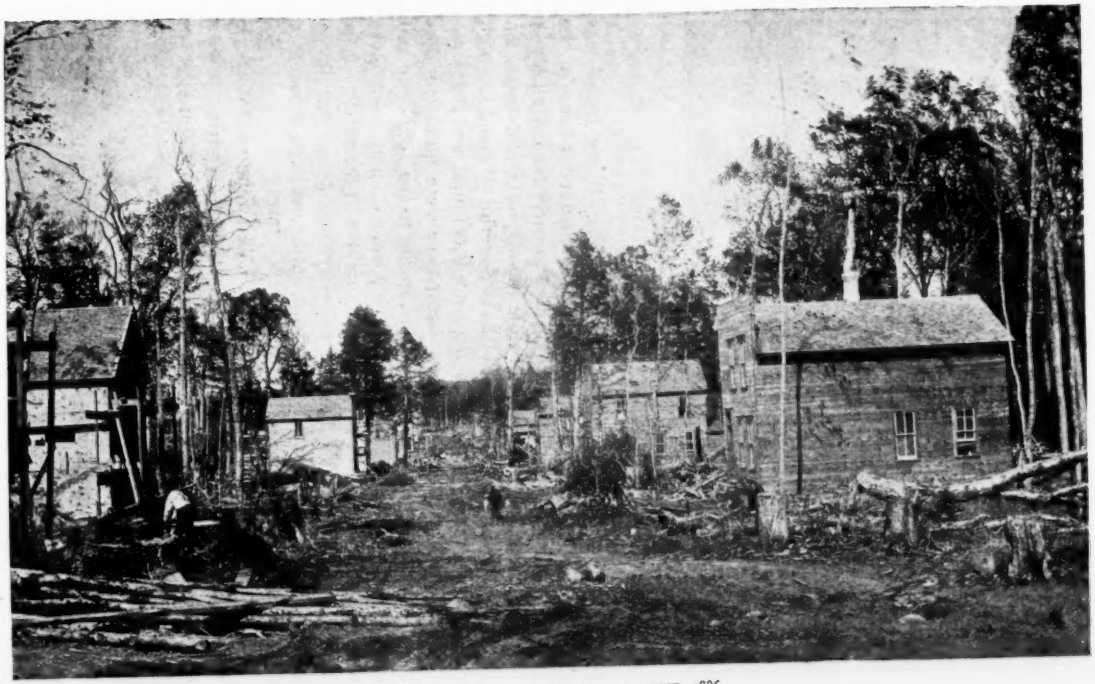
The ore deposits stand at a comparatively high angle and are found in rocks entirely similar to those of the Marquette range. A series of lenses of ore has been opened upon two parallel hills, which constitute the ore-deposits of five or six mines. In the intervening ground, diamond drilling has opened several minor lenses.

"TAKING A WEE BIT SMOKE."
[Group of miners, East Norrie mine.]

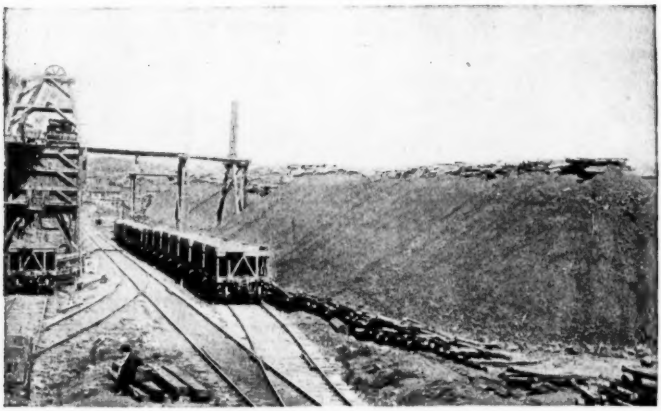
Since 1884, the shipments from the Minnesota mine steadily increased, jumping to 225,484 long tons in its second year, while, to the close of 1892, it has sent away 3,521,838 tons of ore, being a close second to the wonderful output of the mines of the Metropolitan Land and Iron Company of the Gogebic range.

THE MESABA RANGE.

ABOUT the middle of November, 1890, soft hematite was found upon the land now known as the Mountain Iron mine. Ever since 1875 discouraging reports of the district had been given by ex-



THE CITY OF IRONWOOD, MICHIGAN, JUNE, 1886.



EAST NORRIE MINE, GOGEBIC RANGE.
[Shaft No. 1, with Stock Pile.]

plorers and geologists, owing to the fact that all ore found was "lean" or banded with jasper. Others condemned it because the strata which properly might be expected to carry the ore all lay at a very flat angle to the horizon, while the deposits and lenses on the ranges upon the south shore of Lake Superior all stood at a high angle. However, by perseverance the ore was found, and the general conditions which surround its occurrence were quickly understood, and in an incredibly short time, owing to the simplicity and ease of exploration, the range was developed. Commercially there are but two kinds of ore found—the normal soft hematite and a goethite; the latter, a yellow ore resembling ochre but carrying a higher percentage of metallic iron, and, unlike ochre, is frequently found very low in phosphorus.

The ore lies flat, with a dip to south. Very rarely has it a rock covering, glacial drift only hiding it from view. The ore occurs in a jasper-schist, locally known as taconite, from which it appears to have been derived by erosion of the jasper and concentration of the iron-ore upon the underlying greenstone.

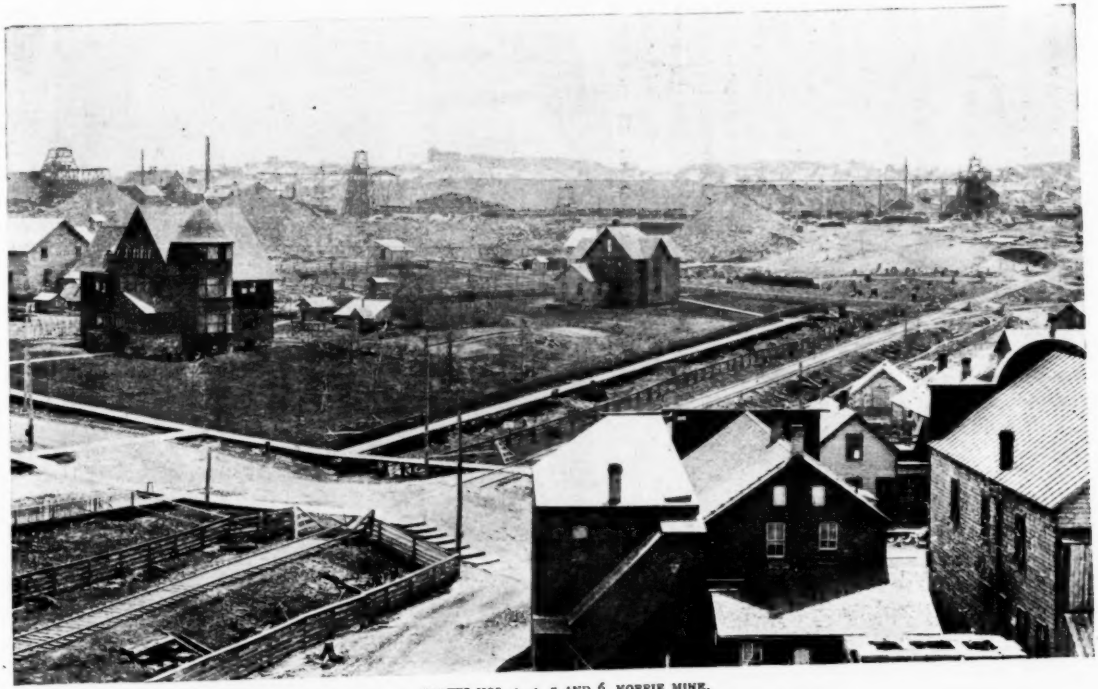
The extent of the range is remarkable, as it has been explored from the Mississippi river as far east as the Canadian boundary on the east, a distance of 140 miles or more. Of course the ore is not a continuous deposit for this distance, nor is the depth of ore uniform. Local causes induced the alteration which has given us the

ore. The surface covering of sand, boulders or clay varies in depth from a few feet to over 100 feet, the depth of the ore deposits following these figures very closely also. Owing to the southerly dip, the deposits are frequently wedge-shaped, with the thin edge to the north and thickening to the south until the ore reaches the unaltered jasper schist.

Following the discovery of ore at the Mountain Iron mine, came, after a short interval, the opening of the Biwabik, Cincinnati, Hale, and then the group of mines surrounding the town of Virginia. The first-named property is the one that has by its phenomenal size, remarkable grade of ore, ease of access and broad scale of attack, made it famous in the Lake Superior region. Its owners were the first to evidence faith in steam-shovels by their works. Starting in a manner characteristic of the broad gage of he management shown by its operations at the Hamilton-Ludington mines upon the Menominee range, it began stripping in the winter of 1892–93, which it has continued until the present month (August, 1893), when owing to the universal depression in all mercantile

EAST NORRIE MINE, GOGEBIC RANGE.

[Shaft No. 2—Caved surface in the foreground.]



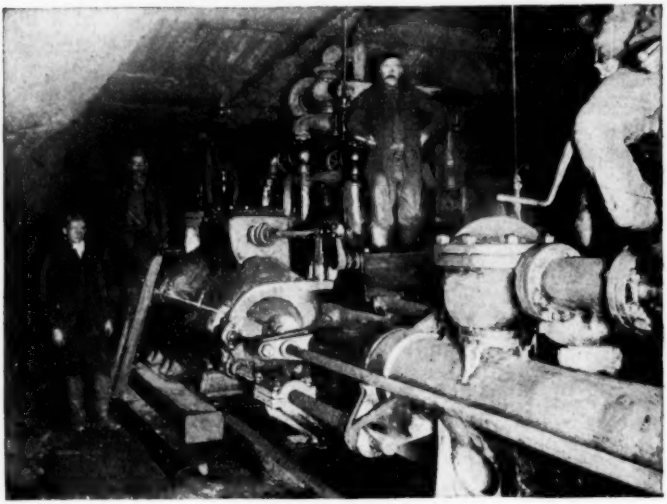
SHAFTS NOS. 3, 4, 5 AND 6, NORRIE MINE.

[Superintendent Day's Residence on the Left. Stock Pile of Ore in the Distance.]

ORE STOCK-PILES, NORRIE AND EAST NORRIE MINES.

[No. 7 Shaft Norrie over the track.]

enterprises, it has temporarily closed down. Not, however, until it had satisfactorily demonstrated that the ore could be handled with ease by steam-shovels. The writer has sat on a bank of stripping watching the shovel, with its two ton dipper, drop down with a rattle of chains and thud to the base of the breast of ore, up which it climbed, tearing out huge pieces of ore which rolled to the bottom, too large to go into the dipper, and on with its load over to the railway cars standing on a side track. These larger pieces were quickly broken by men with sledge hammers while the shovel was busy elsewhere picking up ore and loading the cars. When



NORRIE MINE, GOGEBIC RANGE.

[Big Pump, 800 Feet Underground.]

seen in operation in June last the breast of beautiful blue (Royal blue of the mine) ore was 15 feet or more in height and gaining as progress to the north or into the hill was made. When the necessary tracks are in place, and the thorough-cut completed so that shovels can be operated without delays other than are incident to such a method of loading, there is no question but that 2000 long tons of ore can be loaded by one shovel in a day of ten hours, and when the plans now laid for the stripping of the property are completed, three shovels can be operated that will easily main-

tain a daily output of 5000 tons, provided railroad facilities can be provided for this enormous output.

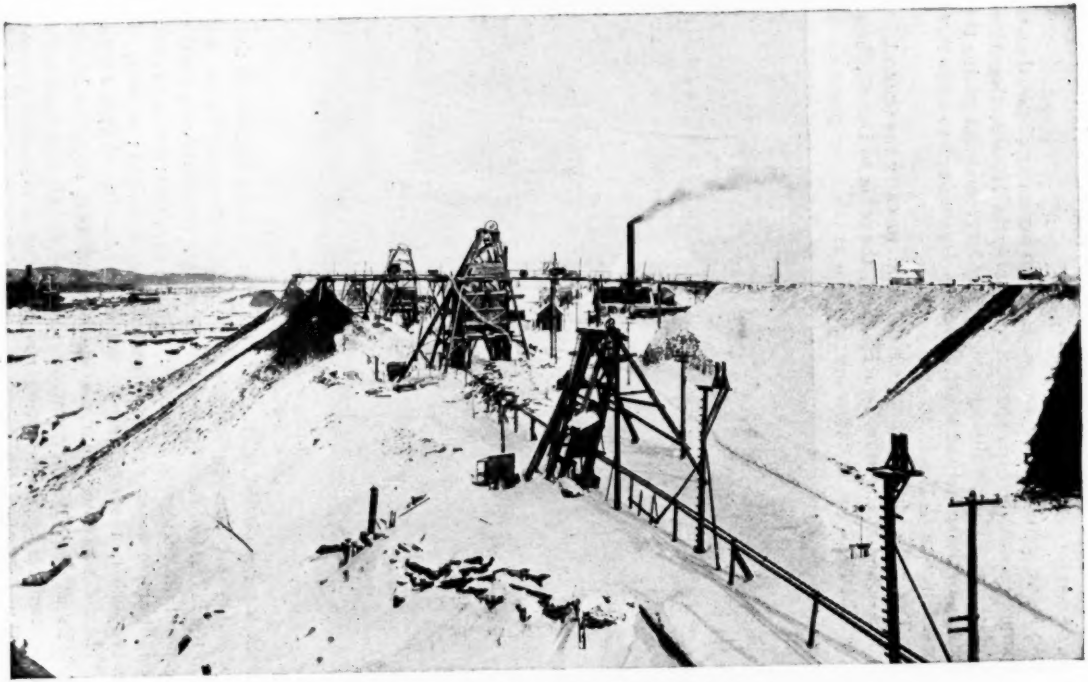
There are several mines which are so favorably disposed as to permit this method of exploitation, notably the Mesaba, Mountain, Adams, and Hale, while others will go underground and pursue the caving or other method which the management deem to be to their best interests to follow, to obtain the ore.

Two railroads have entered the field to carry the ore to lake ports—one to carry it to Two Harbors, the other to Duluth, these ports being about 26 miles apart, while at the latter place a new

NORRIE MINE, GOGEBIC RANGE.
[Pumpmen on Ladderway in the Shaft.]

dock has been building this past summer to care for the ore that promises to be the highest and of the greatest capacity of any on the lakes, and consequently in the world. The following are the general dimensions of this dock: Length, 2304 feet; width, 52 feet; height above water, 53 feet; number of pockets, 384; capacity of each pocket, 150 tons, or a total dock capacity of 57,600 tons.

In order to enter the lists of shipping mines in 1892, the Mountain Iron Company sent away, practically as sample lots of Mesaba ores, two cargoes, amounting to 4245 long tons, which proved satisfactory to the furnaces making a test upon the ore. In spite



WINTER AT THE NORRIE—LOOKING WEST FROM NO. 3 SHAFT.

[Ground Caved to the Left.]

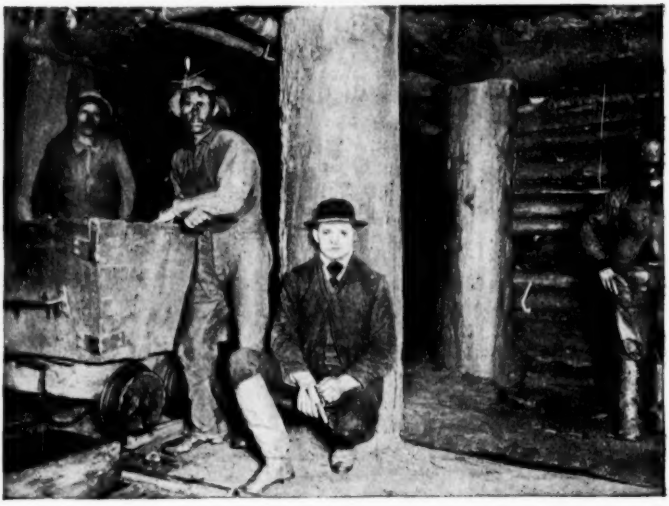
of the drawback of the last season's depression, this range is one that will ultimately prove its strength and value, and be of material assistance to the steel makers of this country, as, with a growing demand for steel, there promises to be a shortage in Bessemer ores. This range will undoubtedly be of great service in forestalling apprehension on this score.

FROM the pages of Census Bulletin No. 113, issued September 24, 1891, some few figures are taken which will partly confirm the statements made and convey to the general reader some idea of

NORRIE MINE, GOGEBIC RANGE.
[Icicles Underground.]

the magnitude of the interests involved. Out of 14,518,041 long tons of ore mined in the United States, this district produced 7,558,176 tons, or something over 50 per cent. Of the estimated total value of the ore produced ($32,766,506) this region is credited with $19,851,191, or over 60 per cent.

In the census year 1889, Michigan headed the list of iron-ore producing States, while Minnesota ranked fifth, and Wisconsin, sixth. Of the capital invested in actual iron-ore mining operations, amounting to $109,766,199, the lake region shows that it has $54,825,122, or just 50% of that of the entire country. Of the total an-



EAST NORRIE MINE, GOGEBIC RANGE.
[Tram-car Underground.]

nual expenditure in the United States of $24,781,658 the three Lake Superior iron-mining States, Michigan, Minnesota, and Wisconsin, spent $15,168,352, or over 61 per cent.

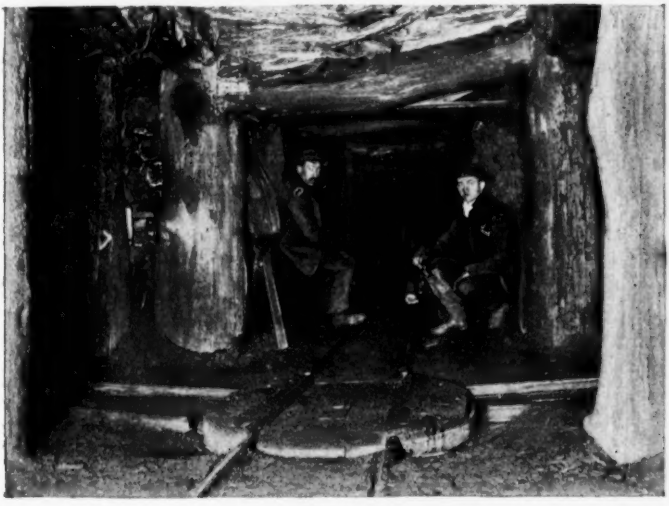
The railroads have a large amount of money invested in docks, cars, and engines, which are intended solely for the iron-ore traffic. Exclusive of engines, for which no returns are available, the following will be an estimate of the investment by the ore-carrying roads in cars and docks only:

Chicago and Northwestern	$2,290,000
Duluth, South Shore and Atlantic	1,491,000
Duluth and Iron Range	1,231,000
Mil., Lake Shore and Western	813,000
Wisconsin Central	645,000
Duluth, Missabe and Northern (estimated)	600,000
Total	$7,070,000

In addition there is the investment in main lines, sidings, switches, round houses, shops, scales, etc., which would amount to fifty millions of dollars at a low estimate. There are five mining companies owning their own fleet of ore carriers, varying in number from four to seven in a fleet, all of modern construction and cost-

ing from $100,000 to $225,000 each, so that in boats of mining companies alone there would be a probable investment of three and one-half million dollars. The receiving docks at lower lake ports represent a large investment solely for the benefit of ore traffic. The ore dock at Fairport, Ohio, has a frontage one mile in length, with room for stocking ore extending back 180 to 350 feet in width. Two docks at Cleveland, Ohio, are half a mile in length, with storage capacity 350 feet in width :—the capacity of the three docks named will reach from 1,000,000 to 1,500,000 long tons each, as ore is stored from 25 to 50 feet in height. With the equipment of hoisting and conveying appliances, some of these docks cost $800,000 ; there are some fifteen receiving docks, located at nine ports, and a low estimate would place their cost at seven million dollars, so that it is readily seen that the Lake Superior iron ore interests easily command an invested capital of at least $125,000,000, and with the advent of the Mesaba range upon the scene of operations they are apt to reach the sum of one hundred and thirty millions within a very few years.

Whether it be a natural law of all ranges or not, it is worthy of note that in every instance, in the iron districts, the deposits first



TURNTABLE IN EAST NORRIE MINE.
[Timbers Showing Weight and Beginning to Crack.]

LOADING ORE AT BIWABIK MINE, MESABA RANGE.

found and developed have proven themselves to be the principal ones of that range upon which they are located. The Jackson and Lake Superior mines on the Marquette range; the Chapin on the Menominee; the Colby and Norrie mines on the Gogebic; the Chandler and Minnesota of Vermilion, and the Mountain Iron and Biwabik of the Mesaba range, all tend to confirm this statement. Again in the far west, the early discoveries of Leadville showed up the mines that have ever since maintained a uniform and steady output. At Aspen, Colorado, the Mollie Gibson; at Georgetown, the old Colorado Central mine; at Butte, Montana, the largest mines were practically all found at the same time and few large ones have since been developed.

The mines of the Lake Superior iron district, in spite of depths increasing every year, are in position to maintain the maximum output they achieved in 1892 for a long time to come. The development of new mines has not tended to this result so much as the bettering of mining methods, and the bringing to the miner's assistance of better powered machinery, new devices, tools, and the application of knowledge gained by long years of experience. The opening of the Mesaba range will not materially interfere with the output or development of the older ranges, as the consumption of ore is increasing annually and the uses for steel are widening, so that it will simply furnish the ore needed for the increased demand.

The foregoing very cursory glance at the several ranges producing iron-ore is incomplete and for that reason unsatisfactory; to fully describe any one of them would take the space devoted to the five, which in a magazine of this nature is out of the question. To the investor they offer wonderful inducements; the legitimate field of mining is more fully developed in the Lake Superior district than in any other of equal extent. As a rule, the stock gamblers are weeded out very early in the history of the development of a range, leaving the miner to pursue the even tenor of his way: the product is as staple as wheat, and while it now is suffering in common with all other industries, it will revive as soon as there is any sign of life in the horizon; for the world must have iron and steel.

NOTE.—The photographs from which the illustrations were made of the Norrie mine and underground workings were kindly furnished by Mr. S. S. Curry, President of the Metropolitan Land and Iron Company. Those taken in 1886 were given to the writer by Mr. J. M. Longyear, of Marquette, who there took them. Those of the Buffalo mines (presented last month) were loaned by the engineer of the company, Mr. E. V. Palmer. The others were specially taken for this paper.—R. A. P.

THE HISTORY OF STRIKES IN AMERICA—II.

By Arthur A. Freeman.

ACCORDING to the historians of the labor movement in the United States the beginning of its second epoch is contemporaneous with the breaking out of the rebellion. The eight-hour movement is held to have received its great impetus during the war. "The demand for arms and equipments, and the distribution of money by bounties," says the editor of "The Labor Movement," Mr. McNeil, "soon compelled more rapid production." Strikes for shorter hours and higher wages followed this revival of industrial activity. While the panic of 1857 had weakened the unions and reduced their membership, and while the increased agitation of the slavery question so engrossed attention that the labor issues were temporarily neglected and it was not really until the end of the war that the full force of the labor revival was manifested and developed, yet the record shows that the circle of organization of workers was nearly completed in 1862. At this time many old unions were reorganized, new organizations sprung up everywhere, and national as well as international associations were created by those who realized that the small and isolated trades union had outlived its usefulness to the laborer. It is stated that twenty-six trades had national organizations in 1860, while many had international organizations. The era of the civil war, says Professor Ely in his history of the labor movement, brought into prominence a vast number of labor problems, due to fluctuations of the currency, rapid accumulation of wealth, and the widening of the field for the labor movement consequent on the abolition of slave labor, as well as to the fact that during the war native labor had been replaced in many quarters by foreign labor. It is not surprising that during the closing years of the war and the five succeeding years a large number of new organizations were formed. From this time forward the history of the labor movement in general is virtually contained in the history of the several large organizations. The movement began to assume a political character, and numerously signed petitions were forwarded to Congress and the State legislatures asking for the enactment of eight-hour laws and other special legislation.

The panic of 1873 and the four years of industrial depression

that followed it, instead of checking labor agitation and organization, stimulated it. Men would organize themselves into local unions whenever they decided to strike, and at the end of the strike would generally dissolve and reorganize into assemblies of the Knights of Labor.

We proceed now with the chronological history of the strikes and disturbances during the second epoch of the labor movement.

In 1860 there was a strike of shoemakers at Lynn, Mass., for an increase of wages. There was rioting and attempts to prevent express companies from transporting stock and goods. Soon the strike spread to other shoe-manufacturing towns in the State. On a certain day delegations from several towns came to Lynn, and over 5000 men and 1000 women appeared in line with banners and bands of music, making the largest labor demonstration ever known in Massachusetts. But the strike failed, the vacant places having been filled by men from other States. There was another strike in the same year, also unsuccessful. In 1861 there were two minor strikes. In 1862 there occurred many short strikes throughout Pennsylvania for increase of wages, and they were generally successful. Coal-miners in Illinois also struck and succeeded after a nine months' struggle. The companies tried to import Belgians, but many of them were sent back by the strikers at the expense of the Miners' Union. There were two other successful strikes in that year.

In the early part of 1863 strikes prevailed in many industries. Several collisions took place between strikers and the police. Assaults on non-union men were frequent. Apart from these, there is a record of fourteen different strikes. There were seven strikes in 1864; in one case the militia had to be called out. In 1865 there were numerous strikes in Pennsylvania against reductions, generally unsuccessful. Six other strikes occurred. The Bricklayers and Masons' Union was formed in that year. Six strikes occurred in 1866. In 1867 there was a general lockout by iron manufacturers of Pittsburgh in consequence of a demand of some for an increase. The workmen asked for a conference with the manufacturers, which was granted. The lockout ended in the manufacturers paying the price demanded. In that year occurred the strike of the Pittsburgh stove-molders against a 20-per-cent. reduction. New hands were employed, and this led to considerable agitation and police interference. The strike was supported financially by the International Union and donations

from outsiders. The molders expended $18,000 in building a new foundry to be run on the coöperative plan, but the enterprise failed, and after nine months the molders were obliged to return to work. The union fell, as strikers had to sever their connection with it as a condition of obtaining employment. There was also a long and bitter fight of the molders in Cincinnati, which resulted in eleven of the strikers starting a coöperative foundry. Several other strikes occurred. In the same year the decision was handed down in the case of the Master Stevedores' Association vs. certain strikers in which the judge for the first time clearly traced distinctions between conspiracy cases theretofore regarded as entirely analogous. The judge held that "it is not unlawful for any number of journeymen or master workmen to agree, on the one part, that they will not work below certain rates, or on the other, that they will not pay above certain prices; but any combination for the purpose of compelling journeymen to conform to any agreement fixing the rate of wages to which they are not parties, by the imposition of penalties, by agreeing to quit the service of any employer who employs journeymen below certain rates, unless the journeymen pay the penalty imposed by the combination, or by threats, intimidations, violence, or other unlawful means," is an indictable conspiracy. In a New Jersey conspiracy case in the same year it was held that it was an indictable conspiracy at common law for several employés to combine and notify their employer that, unless he discharged certain enumerated persons, they would quit his service in a body. The granite cutters were organized in 1867.

During the session of 1868 the Pennsylvania legislature passed the eight-hour law to go into effect July 1. Agitation began in the collieries of the Mahanoy valley for adoption of the law, and a general strike followed. There was a general suspension of work throughout the anthracite coal fields depleting the coal market and making prices high. In September there was a general resumption of work. There were several strikes of spinners and weavers as well as in other trades. The railway conductors' brotherhood was formed in that year. In 1869 several important strikes occurred, notably that of the Schuylkill miners, who desired to fix a minimum price for mining coal. The absence of Schuylkill coal from the market proved a source of profit to the other counties, where work continued without interruption. When, finally, a compromise was agreed upon and work resumed, it be-

came evident that the long contest had ruined the business of Schuylkill county, her former customers having made permanent arrangements elsewhere. The Knights of Labor organization was formed in 1869 by seven men. Sixteen strikes occurred in 1870. In one case Chinese were imported from California to take the place of strikers. In 1871 there were eleven strikes. Spinners, miners, telegraphers, cigarmakers, and other trades figured in the conflicts. Schuylkill county was again the scene of trouble. The operators refused to treat with their employés through the officers of the union, and a dead-lock ensued. The managers of the Philadelphia and Reading railroad undertook to compel a settlement of the dispute by raising their transportation charges to such a figure that no collieries could work unless all were at work under a common agreement. This interference was bitterly resented by both operators and miners and the matter was considered by a committee of the State Senate, which, however, declared itself powerless to apply a remedy. The matter was finally settled by arbitration.

In 1872 a vast body of workmen, perhaps 100,000, mostly of the building trades in New York city, struck for the eight hour system. At the end of three months the strikers succeeded in nearly every instance. In Pennsylvania strikes prevailed in various trades, for the eight-hour system, but they were unsuccessful. There was an interesting strike of the coopers of New York against the sugar refineries using barrels made in other localities. The strikers declared that they did not question the right of the sugar refiners to purchase barrels where and of whom they chose, but that they had an equal right to work for whom they chose, and hence were acting within their right in declining to work for refineries that purchased barrels elsewhere. The reasoning was faultless, and to-day such a contention would doubtless be sustained by any court. There is no record of the result of this interesting controversy.

A notable strike was that of the miners on the line of the Connellsville railroad for an advance of 1 cent per bushel for mining coal. The strike soon spread to mines along the Monongahela and Youghiogheny rivers. The demand was refused by the river operators, but conceded by the railroad men. Over twenty other strikes are recorded for the same year. A few were against wage reductions, but the majority were for a reduction of working hours from ten to eight. Most of the strikes failed.

In 1873 the printers of several Pittsburgh papers struck against a reduction. The Typographical Union took part, but the strike failed, and the union was dissolved. Suits were entered against printers for conspiracy, but were finally withdrawn. In the same year the miners at Arnot, Pa., determined to organize a union, struck in protest against the discharge of eight of the men prominent in the enterprise. A lockout against all union men ensued. An official of the State labor bureau submitted a proposal which the miners accepted and the company rejected. After many months, the opposition to unions was withdrawn, and work everywhere resumed. Several other strikes are recorded, although the year was one of panic and depression. Strikes were also numerous in 1874. Nine thousand miners in Schuylkill county again struck against a proposed reduction, and the miners along the line of railroads leading to Pittsburgh also went out to resist a threatened reduction. Strikers were replaced by Italians, and shots were exchanged between the old and new workmen. In Scranton the miners struck against the demand to fill six instead of five cars for a day's work. New men were employed, and rioting ensued, in which fire-arms were used. There were other important struggles between capital and labor. The strikes were generally unsuccessful. Twenty-five strikes occurred in 1875, and some of them were accompanied by violence. Owing to hard times wages were everywhere reduced, and the strikes against these reductions could not but end in failure. There was no improvement of the situation in 1876, during which year twenty-one strikes occurred. From 1873 to 1876 strikes were especially numerous in the states of Pennsylvania, Illinois, Indiana, Missouri, Maryland, Ohio, and New York. Great bitterness was evinced against trades unions, and men were "blacklisted" to an extent almost unequalled. Nevertheless, men everywhere formed new unions or reorganized their unions into assemblies of the Knights of Labor. In 1876 the different iron-workers' organizations were federated, forming the present great organization known as the Amalgamated Association.

In 1877 occurred the great railroad strikes. The trouble began on the Baltimore and Ohio railroad at Martinsburg, W. Va., the immediate cause being a 10 per-cent. reduction. There were, however, other grievances, such as irregular employment, delay in payment, and assessment of costs of accidents. There was rioting, destruction of property, and loss of life, at Martinsburg, Baltimore, Pittsburgh, and other places. The State militia at Martinsburg

and Pittsburgh affiliated with the strikers and refused to fire upon them, and United States troops had to be ordered from the eastern garrisons. In Cincinnati, Toledo, and St. Louis mobs succeeded in closing most of the mills and factories. In Chicago the Socialists made a formidable demonstration, and in many cities in New York mobs had to be dispersed by the State militia. There are no figures obtainable as to the number of men thrown out of employment in the aggregate by these strikes, nor of the total value of property destroyed in the resulting riots; it has been estimated, however, that the damage which was inflicted by the mob at Pittsburgh alone was $5,000,000. Besides these railroad strikes there occurred in 1877 about forty other strikes in various industries. For 1878 about thirty different important strikes are recorded, and for 1879 about forty. There were also some lockouts. Strikes under the auspices of the Amalgamated Association of Iron and Steel Workers multiplied during 1878 and 1879. Some were for higher wages and some against a species of coöperation favored by the companies, the principal condition of which was that the men should leave in the hands of the companies the first four weeks' wages and 25 per cent. of all wages earned thereafter, the same to be paid at the end of the year, if the profits should justify such payment.

Since 1880 the government has issued an annual tabulated report of labor disturbances. The total number of strikes and lockouts for 1880 is 762. Some of these strikes involved many different establishments. 304 strikes occurred in Pennsylvania, 104 in New York, and 93 in Ohio. The mechanical and manufacturing industries furnished 524 of the disputes, and mining 182. The large number of strikes reported for 1880 indicates the fragmentary character of the information obtained for former years. It is probable that some at least of the years prior to 1880 were as fruitful in respect of labor troubles as was that year.

The number of strikes for 1881 is 471, and the number of establishments involved is 2928. In 1881 the federation of organized trades and unions was formed, its relation to the different trades unions being analogous to that subsisting between local bodies and central labor unions in the cities. In nearly every one of our chief cities there is a central labor union to which the local unions send delegates. In 1882 454 strikes occurred, involving 2015 establishments. In 1883 478 strikes were recorded, and the number of establishments involved was 2759. In 1883 occurred the great

telegraphers' strike, which involved the majority of the commercial telegraph operators of the country. In 1884 443 strikes occurred involving 2367 establishments, and in 1885 645 strikes, involving 2284 establishments. In 1885 the coal miners formed a national federation. The number of strikes for 1886 was 1411 and the number of establishments involved 9861.

In the spring of 1885 the shopmen on the Missouri Pacific railway struck for the restoration of the wages paid in 1884. Four thousand men were involved, and during the continuance of the strike freight traffic was virtually suspended. The governors of Missouri and Kansas brought about a settlement of the troubles favorable to the strikers, who had the sympathy of the public on their side. The big railroad strike of 1886 began at Marshall, Tex., on the Texas and Pacific. A foreman was discharged for alleged incompetency, but as he was a Knight of Labor, the Knights inaugurated the great strike, claiming that the discharge was in violation of a previous agreement, and alleging other violations. On March 1 the shopmen, trackmen, etc., on the Texas and Pacific were called out, and on March 6 the men on the Missouri Pacific and leased lines were also called out. During the entire month of March all freight traffic was virtually suspended on the roads, and about 10,000 men were out of work. On March 28 the strike was declared off, but the companies refusing to treat with the men except as individuals, the order terminating the strike was revoked. In May the strike was again declared off, and unconditionally. Traffic, however, had been resumed before this under police protection, as many of the strikers had returned to work and new men had been engaged. This failure marks the beginning of the decay and the dissolution of the order of the Knights of Labor.

Taking the years from 1881 to 1886 inclusive, an analysis shows that 22,304 establishments were involved in strikes during the whole period, while 2214 had lockouts. The number of employés involved for the period was 1,323,203. The loss to the strikers was $51,814,732, and the loss to workmen through lockouts was $8,157,717. The employers' loss through strikes was $30,701,553 and through lockouts, $3,462,261.

The present construction of the doctrine of conspiracy is shown by an opinion delivered in 1888 by a judge of the New York supreme court. No doubt, he said, exists of the right of workmen to seek by all possible means an increase of wages, and all combinations which have that end in view, if not distinguished by vio-

lence or threats, cannot be condemned. The attempt of a "scab" and disorganizer to reduce wages should not, however, invoke the disasters of a strike. But if this must be done to perfect an organization or to hold it together firmly, it should end there, and should not resolve itself into a determination that the objectionable person, the scab, should be prevented from working for the support of his family within a given district, large or small.

From a study of the facts and figures relating to strikes and lockouts one rises with a firm conviction that these phenomena cannot be due to the subterranean plotting of a few selfish agitators, but must be regarded as one of the inevitable results of the system of free industry. It is as natural for the employer to seek to increase his profits in every legitimate economic way as it is for the workman to try to raise the market value of his labor. Whatever there is of evil in these conflicts between labor and capital tends to right itself, and under freer competition and less legislative regulation the strikes would diminish in number and improve in character. There are undoubtedly better ways than strikes to settle disputes, and self interest is sure to discover and prefer the better ways. It is proper and necessary for the law to intervene when justice is violated, but it is not the duty or business of the law to discourage strikes in general. Business experience and interests should be allowed to determine the course of strikes. Government interference can only breed violence and divert the question into socialistic channels. Of late nearly every great strike may justly be said to have been an attack on the whole system of private property and competitive industry; and for this radical change of attitude on the part of the laboring masses legislation is chiefly responsible. "The remedy for the evils growing out of liberty is greater liberty," has been said; and this proposition may be applied to the industrial relations as well as to the political.

While it is true, on the one hand, that since 1886 the labor organizations have lost considerable ground, and that to-day even the most powerful unions find it impossible to enforce their demands by means of great strikes and "tie-ups," it is also true that the dangers and evils of collisions between employers and workmen are greater now than they ever were. The old trades-unionist had no sympathy whatever with state socialistic notions and was careful to disavow his responsibility for revolutionary attacks on the fundamental principles of industrial society. He merely insisted on what seemed to him "a fair day's wage for a fair day's work,"

and repudiated the radical programme of expropriation and abolition of private enterprise. He had no quarrel with free competition, property, profits, or the right of the employer to be his own master. He claimed the right to strike, to boycott, and to act in concert with his fellows; but he did not theoretically go any greater length. He occasionally resorted to violence, but this was done in the heat and excitement of struggle, and no justification was ever attempted of any destruction of property or interference with liberty. To-day, however, a totally different spirit pervades and controls the world of organized labor. The "new unionism" has virtually espoused the state socialistic doctrine that free competition and private enterprise are incompatible with the interests of labor, and strikes are regarded as the preliminary encounters which hasten the inevitable final conflict between capital and labor. The attitude of the Homestead strikers and their socialist sympathizers in and out of Congress is still fresh in the public mind. Every failure, defeat, and disappointment necessarily tends to drive the workmen into more and more extreme positions. The more desperate the situation, the greater the danger of violence and reckless disregard of bounds set by justice or law. It behooves us therefore to give earnest consideration to the "labor problem," and, by securing to labor its due, deprive it of all excuse for aggression. To avert state socialism, it is necessary to establish economic justice and equal freedom.

THE INCREASING DIFFICULTY OF GETTING GOLD.

By T. A. Rickard, E. M.

THE gold-seeker has ever been the subject of romance, but even the tale of the Golden Fleece and the Dragon can be interpreted in a manner more practical than poetic. It is probable that the fleece of the ram was used in catching the gold of the river Colchis just as we now employ woolen blankets for the same purpose. The story of the dragon was intended to keep Jason and his followers from trespassing upon rich diggings. Thus a weak romance often has hidden a stern reality, even up to the time when the later Argonauts swept over the snowy ranges of the Sierras and penetrated the primeval silence of the Australian bush. But the mists of romance are vanishing. It is only in keeping with the hard, matter-of-fact tendencies of the times that the gold-digger should be stripped of the false poetry which has hitherto clothed him. He stands before us no longer as the amiable hero of a Bret Harte idyll, but as a man, strong and vigorous, searching for wealth with an intensity of concentrated purpose which knows no obstacle and is careless of all danger.

The romance of mining has been its undoing. It is time to tear away the remaining rags of tinsel that hide the true nature of that great industry. The winning of gold, like any other form of human industry, requires the exercise of judgment, science, and common sense,—most of all common sense.

Gold is now rarely got by digging at grass-roots. The discoveries that startled the world in the middle of the century were the product of ages of silent work. Consider the vast period of time which had been required to gather the metal from a state of wide dissemination and to collect it in the places where the miner found it. The frost had shivered the hard rock, the wind and rain had swept the broken fragments into the rivulet, the rivulet had delivered its golden tribute to the rapid flowing river whose waters laid it down in some quiet bend or behind some rocky bar. Nor was this all. Nature, to avoid the undoing of her labor, afterwards covered the golden gravels as with a sheet by flows of basaltic lava which prevented them from being swept away. Cold and heat, wind and wave, the waters above and the waters under the earth, had been

patiently sowing the seed of a harvest which man, the heir of all the ages, was destined to gather.

The great ingathering of the harvest, which began in California in 1848, and in Australia in 1851, was the result of the working of geological agencies during periods of a length to which the time of a generation is as a dewdrop to the sea.

In the days of the first discoveries the pioneers had no thought of the possible exhaustion of the shallow alluvium. The "forty-niners" saw no limit to the golden mosaic which seemed to pave the bed of every mountain stream. Time has told its tale, however, and we now know something of the essentially local character of even the largest deposits of the precious metal. Since the early "fifties" the exploration of unknown regions has, thanks to the hunger for gold, been carried on with intense activity and startling rapidity. The map of the world has been almost filled in. A horde of gold-seekers has restlessly wandered from land to land until it is very improbable that another Tuba or a second Ballarat will soon be found. The mining-fields will be opened up at intervals and in places far apart, new depositories of ore will be uncovered, but it is improbable that, though perhaps extensive and sometimes rich, they will be of that easily-won character which distinguished the shallow gravels of California and Australia. Gold will be won in the future with more toil and expense.

Two facts must be fully recognized. The enormous yield of the few years succeeding 1850 was obtained from surface deposits and shallow gravels, while the production of to-day is obtained for the most part from vein-mining, the gold being torn from the heart of the rocks at depths extending at times to more than a half-mile from sunlight. The past was the era of gravel-digging; the future will be worked by quartz-mining.

In order to be able to weigh the full importance of these facts a reference to the statistics of production * will be required. The world's production of gold has been subject to many fluctuations. No reliable figures are available before the year succeeding the discovery of the new world. From 1493 to 1520 the mean annual production was 5800 kilograms, worth about $3,854,680. For the next century and a half there was a steady increase, so that from 1741 to 1760 the average annual yield had augmented to 24,610 kilo-

* The figures quoted in this paper are for the most part obtained from "The Mineral Industry," by Mr. R. P. Rothwell; the others are obtained from the reports of the director of the United States mint.

grams, worth about $16,456,150. Then came a decrease. In 1821–30 the production averaged only 14,216 kilograms (or $9,448,055) per annum. Again the tide turned. It flowed until it reached high-water mark when gold was discovered in California and Australia. In 1831–40 the mean annual output was 20,289 kilograms (or $13,484,353). In 1841–50 it increased to 59,759 kilograms (or $36,393,598). Then the new worlds of the west and of the south opened their treasure-vaults and the production leaped to an annual average of 199,388 kilograms (or $132,516,056) in the years 1850–55. The highest yield was in 1853, when the world's production had a money value of over $155,000,000. Since that time the yield has fluctuated with a tendency to decrease until 1890, when a gradual increase became again manifest. The old world had come to redress the balance of the new. South Africa began to be an important producer. The yield has been:

	Kilograms.	Value.
In 1889	185,809	$123,489,000
In 1890	170,248	113,149,260
In 1891	181,339	120,518,849
In 1892	196,814	130,816,227

It is well to note that these figures, compiled at the United States mint, have undergone important changes. There has been a great deal of uncertainty as to the actual production of China. Since the publication of the report for 1891 the director of the mint has decided to drop China entirely from the list of gold-producing countries. This has diminished the production for 1890 and 1891 from $120,475,300 and $125,299,700 respectively to the figures above quoted.

In order to understand the full significance of the figures which have been given, it will be necessary to find out to what regions we owe our gold supply and then to follow up this inquiry by endeavoring to determine the conditions under which it is obtained. The current gold production of the world comes for the most part from four countries. In 1892 the distribution was:

	Kilograms.	Value.
Australasia	50,964	$33,870,800
United States	49,654	33,000,000
*Russia	38,822	25,801,645
South Africa	33,207	22,069,578
Other countries	27,560	18,330,249

*The figures of Russia's production are later than those of the director of the mint and are taken from the *Engineering and Mining Journal*, July 29, 1893. The corrected output of the world for 1892 will therefore exceed that given in the mint report by more than two millions.

Gold was first discovered in Australasia on February 12, 1851, by E. H. Hargraves, at Lewis Ponds, New South Wales. In the following July the first find was made in Victoria. Since that date Australasia has produced, up to the end of 1892, no less than 90,715,960 ounces of gold, valued at $1,750,000,000. Of this total the colony of Victoria has contributed no less than 58,101,430 ounces, valued at $1,150,000,000. In 1892 three of the four leading colonies* (no figures for New Zealand are just now available) contributed :

	Yield in Ounces.	Value.
Victoria.....	654,456	$13,481,793
Queensland.....	615,558	12,680,494
New South Wales.....	156,820	2,231,522

In Australasia, as we have seen, two-thirds of the yield has come from the colony of Victoria. In the year of discovery (1851) the production was 145,137 ounces. From 1852 to 1860 the yield exceeded 2,000,000 ounces per annum, reaching a maximum in 1853, when it was 3,150,021, worth about $63,000,000. An enormous output was maintained until 1856, when a gradual decline commenced and continued until the minimum was reached, in 1891, when the yield was only 576,399 ounces. During the last four years the revival of mining at Bendigo has tended to arrest the decline so that last year the production of Victoria increased to 654,456 ounces. From three millions to less than two-thirds of a million ounces is a big falling off. To what is it due? Let the reply come from the royal commission appointed by the government of the colony "to inquire into and report as to the best mode in which assistance could be rendered to develop the auriferous resources of the colony." This commission reported on September 30, 1891, that the gradual decline in the gold yield was to be attributed "to the working out of the shallow but rich alluvium in the early days, first by armies of eager, energetic, industrious, and intelligent men from all parts of the world, and afterwards by large numbers of Chinese, who reworked the abandoned gold-fields; to the difficulties and expense of quartz-mining, and the limited employment that could be given owing to lack of capital; to the spread of agricultural settlement, and, as subsidiary causes, to the shepherding† of mining-lands and the gambling in shares."

*These figures are obtained from the annual report of the secretary for mines of Victoria, for the year 1892.

†Mining claims are leased by the government on condition that work is carried on continuously except for good cause shown; the avoidance of the fulfilment of these conditions is called "shepherding."

This explanation undoubtedly is correct. The two important factors in the decline are the working out of the shallow alluvium and the expense of vein mining. Figures will prove it. Until 1856 there was no quartz- or vein-mining in Victoria. Although the rich croppings of the reefs of Bendigo and Ballarat had previously been broken and crushed by simple contrivances, the industry of vein-mining in Australia may be said to have had its beginning with the erection of the Port Phillip stamp-mill at Clunes in May, 1857. The year which marked the commencement of quartz-mining also marked the beginning of a decline in the gold yield and the first indications of a near exhaustion of the shallow alluvium. The yield from the gravels decreased as the production from the quartz-veins increased. Finally the latter exceeded the former. In 1889 the ratio of alluvial to quartz gold was as 37 to 63. The decline of the former continues. In 1890 the ratio was 35:65; in 1891 it was 32:68, and in 1892 it was 31:69. In 1892 the yield from alluvium alone amounted to 201,958 ounces, out of a total of 654,456. In 1851 the yield was 3,150,021 ounces, all of alluvial origin.

The question arises, will the quartz-lodes redress the balance? In replying one point must not be overlooked: of the present yield from alluvium fully half comes not from shallow placers but from deep leads, old river-beds covered by flows of basalt. The principal mines of this kind, like the Madame Berry at Creswick, are becoming exhausted and no new ones of equal productiveness have been found. The output from the quartz-reefs of the mines of Bendigo and Ballarat will probably continue to increase. There certainly is no sign of any approaching exhaustion, but the gold obtained at depths of from 1000 to 3000 feet is won with a difficulty and at an expense to which the working of the first found alluvium was mere child's play.

Let us turn to the United States. The beginning of gold-mining in this country dates from 1829, when the placers of Georgia were uncovered. From 1792 to the end of 1847 the United States produced a total of 1,187,071 ounces, valued at $24,536,769. On January 19, 1848, Alexander Marshall found gold in California. From 1848 to 1892, inclusive, the United States has produced 94,105,181 ounces, valued at $1,945,156,180, of which California has contributed no less than $1,300,000,000. In 1892 the chief gold-producing States were:

	Yield in Ounces.	Value.
California	580,500	$12,000,000
Colorado	256,387	5,300,000
South Dakota	178,987	3,700,000
Montana	139,871	2,891,386
Idaho	83,271	1,721,364

Even to-day California produces three-eighths of the total production of this country. The greatest yield from that State occurred in 1851, when it was $81,294,700. The date of the maximum output coincided, as in the case of Victoria, with the inauguration of quartz-mining. The first stamp-mill was erected in Mariposa late in 1850, but it was in 1851 that serious work was first begun upon the lodes of Grass Valley and Amador. From 1851 to 1858 the production of California was maintained at a high level, but from 1858 to 1882 there was a steady decline. In 1882 the yield was worth $16,800,000; in the following year it fell suddenly to $14,120,000, and in 1885 it had declined to $12,700,000. This marked decrease was due to the general cessation of hydraulic-mining due to what is known as "débris legislation." Since 1885 the production has not varied much. In 1892 it consisted of 580,500 ounces, worth $12,200,000, as estimated by the director of the mint.

It is time now to inquire into the relative production from the alluvial gravels and from the quartz-lodes. In 1851 the entire product, $81,294,700, came from shallow alluvium. In 1881 the yield of California was $18,200,000, and about one-half was of alluvial origin. In 1892 hardly 10 per cent. of the production was derived from the gravels. The obstacles raised to the carrying on of hydraulic-mining, due to the filling of the river channels with tailings from the mines, caused an immediate diminution of the yield of from $6,000,000 or more. This was in the years 1882-84. All hydraulic- and placer-mining, however, did not cease at that time. In the northern parts of the State several rivers have been declared unnavigable and the country tributary to them is therefore exempt from débris legislation.

In California, as in Victoria, the shallow rich alluvium has been for the most part exhausted. There remain the much less rich but far more extensive bodies of gravel laid down in ancient river-beds. The value of these has been much exaggerated. Statements have been made that upon the full resumption of hydraulic-mining the State of California would increase its yield by from $15,000,-

000 to $25,000,000 per annum. What can be done may best be judged from what has been done. When hydraulic-mining was stopped the output from this source was from $6,000,000 to $8,000,000. When it is resumed the mines may contribute an amount equal to that of their former production. The full resumption of work at the hydraulic mines which were closed in 1882-89 will not, however, be lightly undertaken. The plant of most of them has largely gone to ruin. The capital required to recommence operations on the former scale will be very large. The margin between profit and loss is very small.

Vein-mining in California is still in its early youth. It is destined to a future of great usefulness and steady production, but it cannot, so far as we can now see, hope to redress the heavy diminution in the yield of gold caused by the rapid exhaustion of the more shallow deposits.

The third country in order of gold production is Russia, which has been a steady producer for the greater part of this century. Gold-mining may be said to date in Russia from the year 1745, when auriferous quartz was found at Ekaterinburg, in the Urals, and in the Altai. Nearly a century elapsed before the industry reached any great importance. In 1814 the production was 263 kilograms, worth $174,783. It did not increase much until 1822, when the total was 20,335 kilograms, worth $13,514,712. From the beginning of 1848 to the end of 1892 the total yield had a value of no less than $930,910,677. The highest production for any single year was in 1880,—namely, 43,273 kilograms, worth $28,759,860.

Gold-mining in the Russian empire is still in its early stage and the alluvium supplies the bulk of the yield. In 1892 the production was thus distributed: Oural district, 11,532 kilograms; Tomsk, 6891, and Irkoutsk, 20,399 kilograms. The Ural mountains have long been an important mining region and supply nearly all our platinum. Irkoutsk is near Lake Baikal, while Tomsk divides the distance from the Urals. Of the large amount contributed by the Irkoutsk district, which includes the vast area of eastern Siberia, no less than 18,714 kilograms were the product of private mines, as distinguished from those which are the property of the crown. In 1890, of the total yield of Russia, only 7 per cent. came from vein-mining. Mining, like politics, in the Russian empire, is wrapped in some obscurity which the new trans-Siberian railway will do much to remove. This colossal undertaking is making good progress; it will traverse the whole width of the Asiatic do-

minions of the czar and do much to lessen the costs, hindrances, and difficulties inseparable from mining when carried on at a distance of hundreds of miles from the source of supplies.

Africa has only recently resumed its place in the foremost rank of gold producing countries. The history of its first production in the dark continent would take us back to a time when Central Europe was a wilderness and America unknown. Nevertheless the region which constitutes nearly all the present output of South Africa is essentially a new mining district. It was in 1884 that the De Kaap was discovered, but the "banket reefs" of the Transvaal were not uncovered until the following year. The ancient diggings recently found in Mashona and Manica land have as yet more of historic than economic importance. The growth of gold-mining in the Transvaal is told by the following record of production:

	Yield in Ounces.	Value.
In 1887	43,155	$ 755,212
In 1890	494,817	8,434,486
In 1891	729,238	12,433,754
In 1892	1,210,862	21,190,085

The auriferous deposits of the Transvaal, more particularly those of the Witwatersrandt, are generally spoken of as "reefs," the colonial equivalent of "lodes" or "ledges." As a matter of geological fact these curious formations (locally called "banket") are conglomerates whose tilted position is their chief claim to be considered as quartz-lodes. From an economic point of view they certainly cannot be classed with alluvial deposits, since they are being exploited by methods exactly similar to those used in ordinary vein-mining.

Of their enormous extent, uniform richness, and comparative inexhaustibility we have heard much of late. Recent borings have indeed proved geological reasoning to be correct, and have indicated that this, the newest of the great gold-fields of the world, has an enormous extent, both in strike and in dip. The pioneer of 1849 will tell you, however, that he never dreamt that the placers of California could begin to become exhausted; yet within the time of his generation he saw that the cream could be skimmed. It is indeed true that the deposits of the Rand are entirely different in their character from those of California, and that we listen to the statements of men who have an experience and a knowledge undreamt of by the vigorous but ignorant pioneers of 1849. This is allowed, but on the other hand we must recognize that the conditions under which

gold is won in 1893 in the country beyond the Vaal river are entirely dissimilar to those which obtained in 1853 on the Yuba. The gold of the former is got with far more difficulty. The yield per ton of ore averages about half an ounce at Johannesberg to-day; it averaged perhaps ten times as much in California forty years ago. The quantity of gold won by two men, with a shovel, a pick, and a rocker, in the latter case, is obtained by ten men and ten stamps in the former. The capital of the early Californian consisted of his energy and a few simple tools, but the Anglo-American in South Africa must spend many thousands of dollars in developing an extensive mine and in equipping a ponderous mill.

The conclusion, therefore, is that while the new gold-mining regions of South Africa will very materially add to the production of the precious metal, yet the conditions under which it is there obtained are such that even at the present time, when no great depth has been attained and when the treatment of the ore has as yet offered no very serious difficulties, it is won at such an outlay of capital, labor, and supplies as to prevent any approximation to the conditions and results which marked the mining of the years 1851 to 1855 in California and Australia. What is true of this new district of the southern hemisphere is also true of the older mining regions of the world. A direct comparison between the cost of working shallow alluvium and the expense of the exploitation of a quartz lode, several hundred feet underground, is difficult to make. The great contrast between the two methods of working, however, is evident: the former requires, in comparison to the yield, but little labor and less capital; the latter is an undertaking of a serious character, requiring the investment of much capital to commence operations and of more to continue them until they become profitable.

There are many regions where gold is known to occur in notable quantities, but under very unfavorable conditions. Extensive, and as yet comparatively untouched, deposits of auriferous gravel are known to exist in the deserts of western Australia, on the table-lands of Brazil, in the interior of Guiana, in the undeveloped regions of some of the Central American states, in the river-beds of Colombia and Uruguay, in the wilderness of Siberia, in the veldts of Central Africa, and in many other places scattered the world over. To predict a near exhaustion of the gold deposits of the globe would be foolish, but it is certainly true that the difficulty of the getting of gold is daily increasing.

ARCHITECTURE AS A PROFESSION.

By R. W. Gibson.

THE average professional man, fairly successful as a lawyer, physician, or architect, would perhaps find it difficult to explain why he followed his particular avocation. He might, even in admitting that he liked it, confess an opinion that he would have better succeeded in some other pursuit; that he could have been richer, or less hard-worked, or more healthy. Or, he might say frankly that he did not like it, but circumstances had thus arranged themselves and him, and he accepted the fact. Naturally the prosperous man would most often confess to a pleasure in his work, but whether that pleasure were the effect or the cause of the prosperity might still remain an open question in his own mind. His appreciation of his chosen career would certainly not be attributed by him to the pecuniary emoluments it afforded; for it has never been urged that any of the professions offer a tempting or easy highway to wealth. The professional man too often sees his schoolmate, who in earlier days stood many places below him on the class list, now amassing a fortune in a trade which he, the enthusiast, used to despise, and now marvels at. He sees his friend of later years presiding over a hundred employés, each one guiding a runnel of dollars to trickle into the president's river of prosperity. For himself he knows that all this is impossible. It is not merely remote; it is out of the question. A man can never hope to enrich himself in a profession as he might in commerce. On the contrary, he finds his own vaunted talents obliged after all to wait upon these reservoirs of opulence for their opportunity, for their very permission to move. Art and Science, Intellect and Genius, the handmaids of civilization, are in the end only handmaids, and are bidden and curbed and paid by those who control that circulating life blood of trade, money. And even if a wholesome disposition and a sufficiency of food keep him in a fairly contented frame of mind, he cannot but ask at times whether it is not as much satisfaction to employ artists as it is to be an artist.

The dependence of art and letters upon wealth is too old a fact to need demonstration, and the share of wealth allotted to their ministers is notoriously small. Why then do men of full understanding continue to accept the conditions, and practice any

of the learned or artistic professions instead of the more profitable commercial callings? The answer lies in a principle of social economy, which, although it is elementary in its science and general in its terms, may be very useful to us in a particular application. Let us devote a few new words to this old principle and then apply the argument to the choice of a modern profession.

That man works to live is a truism. Indeed it is so true and so generally accepted that it is apt to be overlooked. The impulse to work has become in this industrial age almost an instinct. Men who are not compelled by hunger, or even less imperative desires, still work like squirrels hoarding nuts in a cage constantly supplied. But notwithstanding these exceptions the rule remains. We work to live.

The prime motive of all labor must then be admitted to be the pecuniary gains which purchase the necessaries and pleasures of life; and the earliest deduction from this argument must be that (other things equal) he who gains most is most to be emulated. But other things are not equal. It is self-evident that the enjoyment of what is gained is as great a factor in the question as its acquisition. Many occupations by their nature detract from the pleasure of life, some by demands upon the physical endurance, for which an age of mental rather than bodily cultivation does not fit all individuals, and some by being so engrossing or so monotonous that the higher faculties are discouraged. On the other hand, many occupations offer for such as are suited to them positive additions to the satisfaction of living, by their intellectual character and associations, gratification of ambition for power over others, for fame and public approval, and for that personal pleasure which usually attends the successful exercise of skill.

The ranks of the professions are without doubt filled with men to whom the advantages last named appeal more strongly than the pecuniary reward to be expected, and among them architecture holds a very high place. In recent years, indeed, so much has been accomplished by architects in the advancement of their art that it may also be said now to be foremost in popularity. Not by numerical test; there are not nearly so many architects as lawyers; but in popular appreciation it is as desirable a profession. Why?

Let us now apply our analysis of the complex motives which we found in a man's impulse to work and in his selection of the kind of work. The objects are, first, pecuniary gain; second, an

agreeable way of life. Architecture is supposed to offer a very happy adjustment of these two elements, and there is no doubt that the supposition is supported by many facts within the range of ordinary observation. An architect in good practice earns an income which enables him to obtain all the necessaries and some of the luxuries of modern life. A man of fair ability and energy no doubt is usually able to fulfill and enrich his destiny with the love of wife and children, and even perhaps to save a few thousands to guard them from actual want, and to educate and equip the young ones fairly for the contest awaiting them. And perhaps a few architects—one here and one there—become well off according to a very moderate standard of wealth. But the popular opinion is sadly in error in ascribing to architects as a class the enjoyment of such fat fees and light labors as occasionally appears to be the case in a newspaper revelation. There may be some rich men who are architects, but they were not made rich by architecture. The biggest prizes in this profession do not equal in profit the great ones of medicine or the law, nor, when the onerous character of the work is considered, the brilliant successes of painting. But perhaps the differences in this regard are slight.

All the professions may be said to offer, to such as can reach their upper ranks, positions very like those imagined as normal by idealists. Bellamy and others have represented life somewhat as modern successful professional men live; except that as a rule the amount of work done by these of to-day is far in excess of the ideal, and that the relative social position is overwhelmingly different in the presence of the money measure of greatness which rules to-day. There is to be found here, however, a compensating fact which carries sentiment into realities. The personnel of the profession includes very many men whose own energy has been their sole resource and whose success with even such limitations (as they seem to others) is satisfactory to them when weighed with other gratified desires. When these were enthusiastic recruits, the prospective ten thousand a year, which gleamed like a lighted beacon ahead, seemed, with the honor and fame attendant, almost as great a prize as a hundred thousand. And though the supposed beacon may prove a will-o'-the-wisp and the ten thousand never be reached, or when reached prove an inadequate stipend, some of the hopes are realized and much of the enthusiasm will find realities to justify it to such men as these. There are many indeed in each of the professions who cannot be called successful who yet manage

to get along somehow, to make a living and to laugh once in a while. All this is well. Decadence may surely be expected when in any country the professions become accessible only to the wealthy, when expense deters education, or law-sustained barriers keep out the ambitious energy of the penniless student. Happily no such mischief threatens here. The schools and mysteries of law and medicine are free and accessible. In architecture indeed an opposite evil is to be overcome. Broadly speaking, there is no education to be purchased, there is no supply, and there is but little demand, because there are no barriers to separate the educated from the uneducated. It is true that at a very few places a very small number of young men study architecture after fashions more or less primitive, but they are so few and of such fashion that, compared with the great need, they are of no account. In one way they are important; they are the beginnings upon which better things must and doubtless will grow. The absence of schools and tests is a great factor in the development of American architecture. It is not without some secondary advantages. It is far better that there should be no school at all than that the school system of some European countries should prevail. Individuality, which is the basis of artistic progress, and which thrives in this country now, is easily crushed out by ponderous pedantry, and the independence of youth which dares and does so much among us will become timid when academies frown with authority as they grow old. The technical school, hitherto, has been so apt to put technique before all else that it will be hard to avoid the evil here. We can afford to make haste slowly. Another fact worth noting is, that in the absence of schools,—technical schools, I mean,—and in the presence of a critical public and a high degree of general education (which situation is fast approaching), there is much greater distinction for the fewer number of students who do achieve knowledge. This is not a permanent condition, nor could it be desirable to have it so, for natural competition rather than monopoly will always produce better results, if there be a competent judicial ability to distinguish them. But it is undoubtedly true to-day that a good architectural education is to an able man worth the more because of the difficulty of obtaining it. This is one of those favoring opportunities attending the early ventures in any new field.

Architecture as to-day practiced in America is a new occupation. A generation ago there were almost no architects. Nearly all the men so calling themselves were self-styled "practical"

men, which usually meant mechanics, a little above their fellow-carpenters in achievements with the square and pencil, and content with an ability to plan one house like another, or, if a better house were wanted, to enlarge the plan and so make it bigger, which was their only conception of the possibility of improvement. All this has changed in the last thirty years. Architects of the new school are accustomed to think that they have brought about the advance and to congratulate themselves, and thank their leaders. But while the profession at large, and by its organized Institute, may have done something, it has been a trifle compared with the progress accomplished. The architects of to-day individually show remarkable energy and skill, and unsurpassed ability, but collectively they are as conservative and inert as the oldest of Europe's corporations. This, too, is a natural outcome of the past, or rather the absence of any past. The American Institute of Architects has a magnificent field and opportunity. It will some day be one of the most powerful and respected of national societies. Soon, when we have traditions of recognized value, they may stimulate us to a regard for the future ; that future which is never understood until it has gone. Now, perhaps, we are too busy. Then we shall have schools of architecture indeed,—great rivals in great cities whose differences will work more for unity than their agreements do now. Then we shall have a law defining some standard of technical knowledge and skill to justify the taking of the appellation of architect. Then we shall have a code by which a business man can ascertain what an architect is to do for him, and what he will not do. Then too we shall have a code of ethics for the guidance and governing, and sometimes the protection, of architects by themselves. Then we shall have in Government architecture the best work of the time, fit examples to educate and elevate the living generation and to stand as memorials of honor. Then we shall have an Institute of which every architect in the land will be a graduate and a member, not as a matter of dry duty, but because of evident benefit to him professionally, intellectually and morally. But all this is of the future, and the present is awaiting us.

The distinct advantage which architecture has gained in recent years, and the improved position the profession to-day enjoys in American cities, has arisen partly from the comparative newness of its work, but chiefly from the altogether new appreciation of Art and Science by the public, and more especially for business purposes. The design of the commercial buildings of to-day is beyond the

capacity of the rule of thumb carpenter-architect of the past. Both the constructive science and the artistic motives are simply outside his mental horizon. A new order has arisen to meet a new demand. Not only architects, but a general advance and progress have placed the profession in its present honorable position. We can hardly say that capital is paying for fifteen-story offices or World's Fair palaces because there are architects competent to design them. It would seem more natural to suppose that the opportunity arose first, and the architects, like other quick-witted men, equipped themselves and supplied what was demanded.

An artistic awakening is an important point in the new era. The perception and understanding of beauty in architecture by so many people and such diversity of people render it paying to make a business building beautiful, since higher rents and more prosperous tenants come with attractive expression. This is what has kept the modern giants of building construction in the hands of architects and out of the hands of engineers. Science is not any more self-sufficient than art. The architect has not cultivated Art to the exclusion of Science. If the engineer had been equally wise, if he had cultivated art, even to the extent that the circumstances demanded, who knows? it might have been hard to draw a line between them.

One thing which modern architects have themselves wisely and nobly made for their profession is a clean reputation for sterling integrity beyond the example of the times, and this is the more commendable since we recall the slough of turpitude in which the carpenter-architects had submerged all their operations. Once in a while we may still run upon some foul spot, but the architect who elects to be honest no longer finds any difficulty. Not twice in five years will he be reminded of those illicit commissions and bribes and presents which formerly were a regular part of the system of business of every builder and material dealer.

In this profession good reputation is a stronghold. An architect has many duties almost judicial in their character; and very much more than is commonly known of plain executive business no more artistic than produce dealing is. Compared with the other fine arts architecture enjoys a place among the things practically necessary. This is not to be despised. The intrusion of the element of utility which has so often led to a challenge of architecture's artistic status has also given her a position among the wealth producers, which painting and sculpture and poetry do not enjoy.

Whatever prestige may be lost from the ideal standpoint of an imaginative art in the modern elasticity of the term architecture, is practically made up in the general benefit and strengthening of its hold upon the public by more familiar use. It may be argued that even the loftier aims of architecture are assisted by those utilitarian works which, though mean in themselves, afford profit and bread and butter to the artist who must live.

The modern architect is of necessity so much of a business man that the fine art is almost in need of a new school of prophets. After all, how little of all we do really deserves the name of architecture as did the Grecian temple, the Roman triumphal arch, or the Gothic cathedral. Some does, but how little! And what delight it is to an architect, what a rare delight, when once in two years he finds himself absorbed in some real study of real architecture,—the fine art, and not the commercial science. An architect is supposed by some people to be always at this exalted and noble occupation. He only knows the nineteen days of figures and specifications and plan problems of the "pons asinorum" order, and of office and "job" management and routine, which await him for each day of art.

At the same time it may be noted that architecture, being a comprehensive profession, affords scope within its limits for great variety of talents. In its general practice there is so little definition, so much individuality, that success can be achieved by widely differing methods, and its specialized departments are so many that the poet and the engineer can each find some employment.

The profession of architecture, therefore, commands respect and draws recruits, not so much by promise of great gains as by the offer of an honorable, intellectual career,—one which permits of the cultivation of the refinements and higher pleasures of life, and at the same time promises an income sufficient for all actual needs and for a few superfluities. The respectable position in the esteem of the community undoubtedly is taken as one of the chief compensations for the arduous duties performed. It is a good sign of a wholesome civilization that it is so.

As viewed by the young man on the threshold of active life, Architecture appears in her most attractive aspect from her most flattering distance. The choice of a profession is a difficult matter and a somewhat uncertain one, whether made by the individual whose interests are at stake or by a guardian for him. In the former case defective knowledge is complicated with very positive

notions and headstrong confidence ; in the latter, good judgment is often handicapped by doubts and anxieties. Probably, after all, chance, the mere accident of circumstances, decides as many of these questions as selection does, and decides about as well. If one adopts architecture as a profession, it had better be of his own free choice. He must be an enthusiastic student ; mere assent or willingness will count for nothing. He should commence actual work early in life, and study and gain experience at the same time, and then, with quick energy, executive ability, and tact— which are far more important than the "taste for drawing" and the dilletanti acquaintance with art which probably suggested his course— he will surely achieve something ; and if he develop that rare combination of true artistic feeling with the business qualities already quoted, then he will be the ideal modern architect.

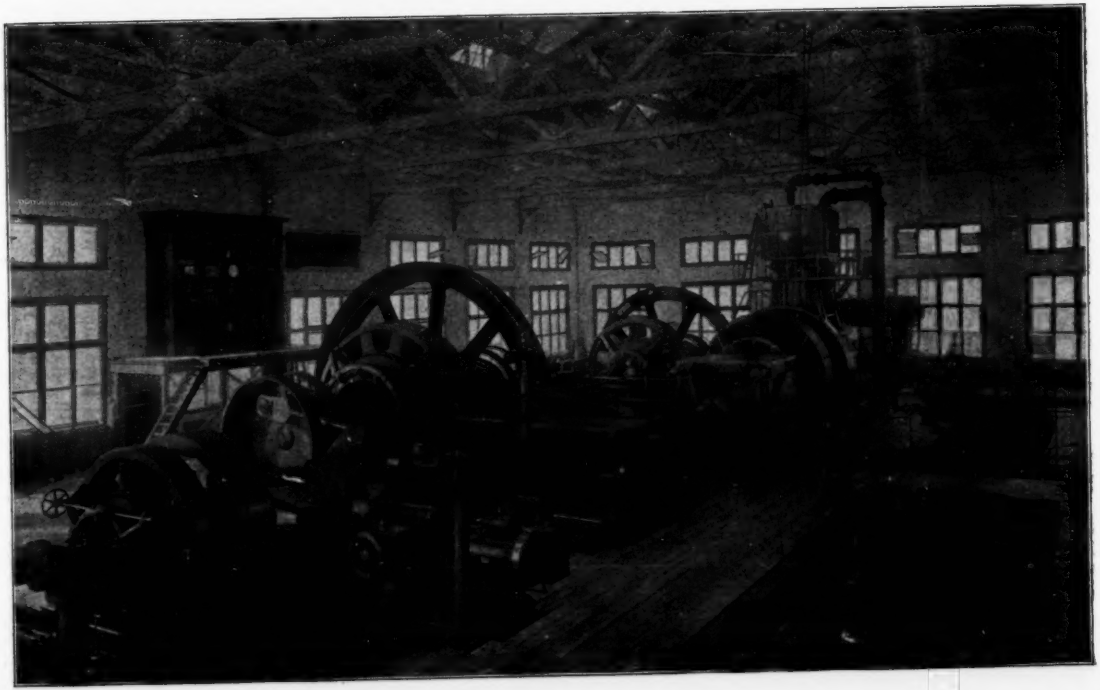
ELECTRIC POWER AT THE WORLD'S FAIR.

By Nelson W. Perry, E. M.

MACHINERY in motion has a charm that is lacking in the mechanism when at rest, yet to the student or specialist the latter may have a special interest akin to that which the corpse has for the anatomist. But the masses are not anatomists and are interested only in the moving wheels. Therefore, because much of the machinery in the Electricity building at the World's Fair was not in motion, many visitors criticised the display. "Separating the motive power from the tool," they said "is like divorcing the breath of life from the body." The exigencies of the case were such, however, that it would have been impracticable to furnish steam throughout the grounds, and it was properly confined in its uses to the Machinery Hall. Upon electricity therefore devolved the duty of transmitting power to the various buildings where it was to be used, and how well it performed the task there are millions who can attest.

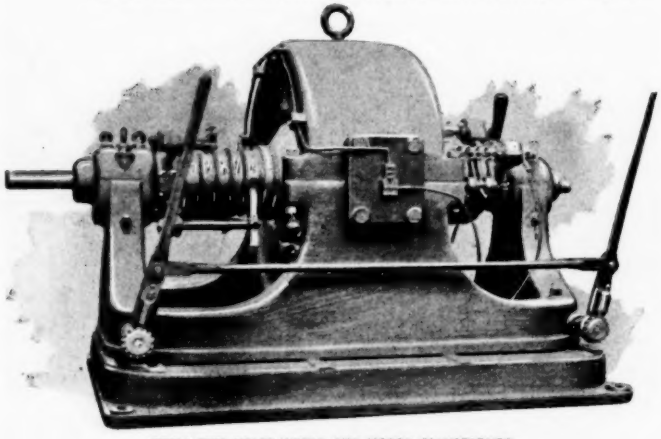
The fact that in some cases the energy thus transmitted had to undergo several transformations to adapt it to the desired use was a source of annoyance and expense which some exhibitors were unwilling to bear. The excessive demand for current which could be met by the supply only in part, and sometimes only at exorbitant charges for wiring and service, furnished a cause for many more idle wheels, but when it has been stated that all the machinery in motion at the Fair outside of Machinery Hall, as well as some of that within, was moved through the agency of electricity, enough has been said to indicate in a general way the extent to which it was thus used. Two exceptions must be made, however, to the statement regarding power outside of Machinery Hall: the power-house of the Intramural railway had its own boiler and engine-plant, and a portion of the power in the Mining building was furnished direct by steam.

Exactly how much energy was transmitted electrically for power purposes it is impossible to tell, but as a basis for an estimate it may be mentioned that in the great power-plant in Machinery Hall the generators catalogued on page 332 were employed for power purposes alone:



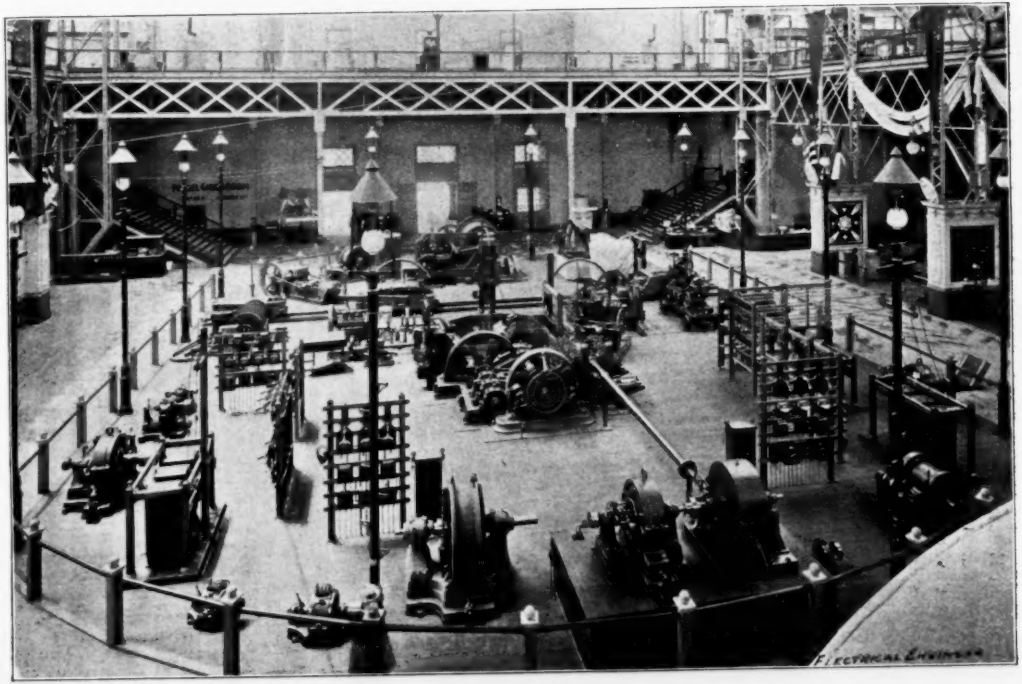
INTRAMURAL RAILWAY POWER-PLANT AT THE WORLD'S FAIR.

Makers.	No. of Generators.	Kilowatts.	Voltage.	Total Kilowatts.
Exposition:				
Mather	2	225	550	450
Mather	2	120	550	240
C & C	4	80	550	320
C & C	2	80	250	160
Eddy	4	186½	550	746
Westinghouse	1	373	550	373
Exhibitors:				
National	1	80	500	80
Jenney	1	40	500	40
Western Electric	2	137½	250	275
Wood	1	500	550	120
Total kilowatts				2,804
Capacity of Intramural power-plant				3,700
Grand total, kilowatts				6,504



TESLA TWO-PHASE MOTOR AND MOTOR TRANSFORMER.

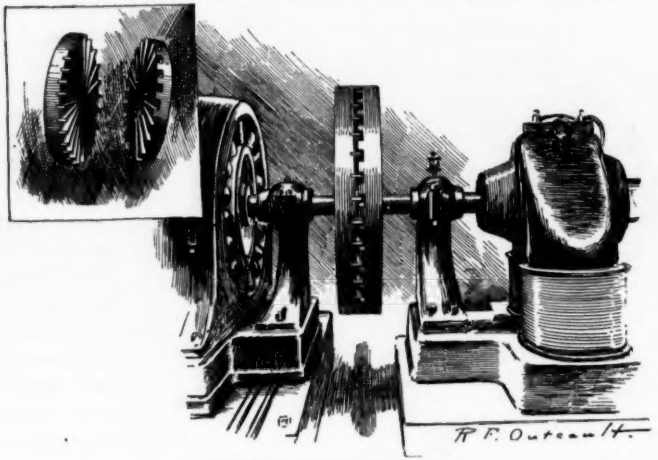
To this may properly be added the power generated more especially for lighting purposes, but which was employed in part by exhibitors or concessionaires for other purposes, and here is where the figures may become uncertain. As an illustration may be cited the four 150-kilowatt Edison generators primarily intended to supply current to the electrical fountains, but which after 10 o'clock at night were employed to charge the storage-batteries in the electric launches. There were fifty-eight of these launches, each equipped with a 4-horse-power motor. The Westinghouse com-



THREE-PHASE POWER-TRANSMISSION PLANT OF THE GENERAL ELECTRIC COMPANY.

pany used two of their single-phase lighting circuits to supply current to their polyphase power-plant, the central figure of their display in Electricity building, and other lighting as well as power currents were transformed by other exhibitors for power purposes, so that the actual horse-power of motors in operation at the Fair was considerably in excess of that indicated by the table. Certainly the rated capacity of electric machinery actually doing work at the Fair did not fall far short of 9000 horse-power, and the work performed embraced almost every variety known to the arts.

Owing to the fact that no steam was permitted in the Electricity building, all generators there shown in operation were driven by electric motors deriving current from the main generating plant in

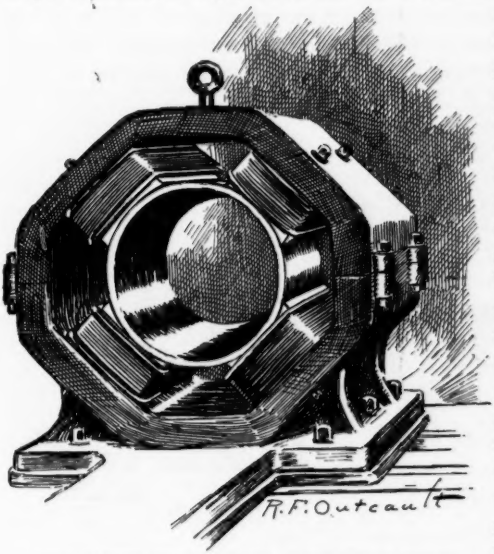


CLUTCH, OR COUPLING, IN DETAIL.

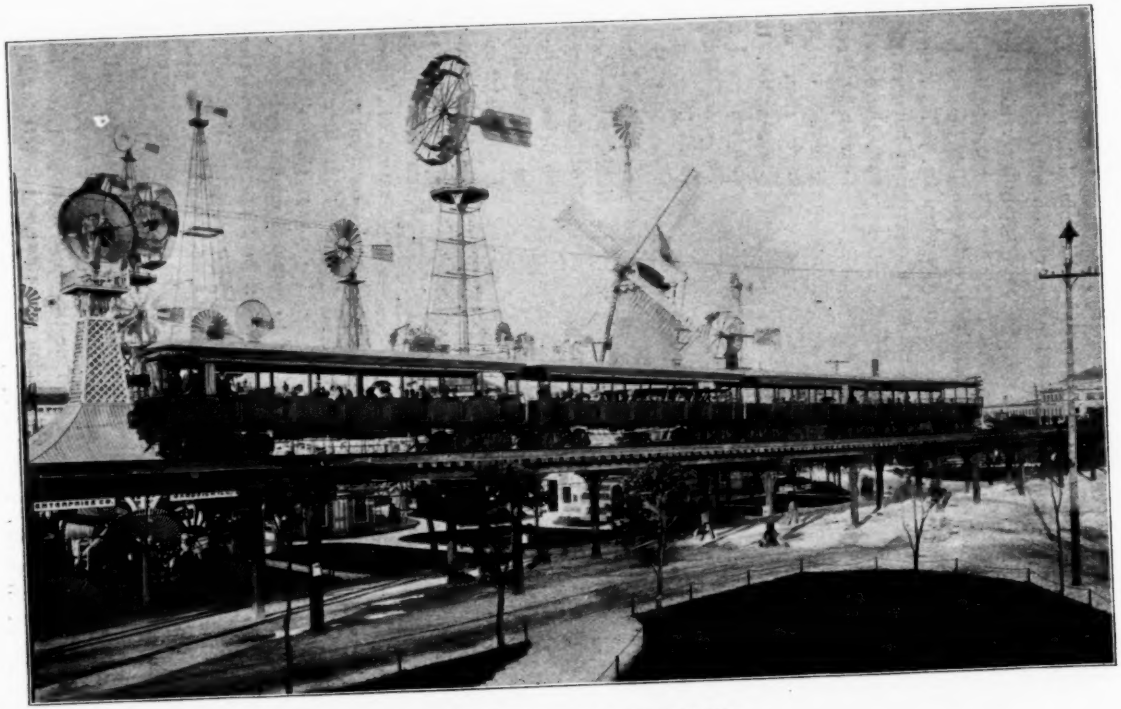
Machinery Hall, and these generators, in order to give them a load, not infrequently supplied current to other motors, besides furnishing the individual lighting supply of the various exhibitors. In this way such an exhibit became a subordinate central-station, itself operated by electricity, and which, in the cases of the Western Electric Co. and the Fort Wayne Electric Co., supplied current for power and light at a stipulated rate to other exhibitors. All of the direct-current incandescent lighting in Electricity building, as well as a considerable portion of the alternating-current incandescent and direct-current arc-lighting of individual exhibitors, was thus provided, constituting this by long odds the most extensive

illustration on a practical commercial scale of the principle of the correlation and conservation of energy.

It seems a little strange that this fundamental law of nature should have been first discovered in the relation between mechanical work and heat, for while the most superficial observation might have taught that mechanical work was always accompanied by heat, it was not so apparent that there could possibly be any definite relation between the two. Therefore when Dr. Julius Robert Mayer asserted, in 1842, that there was a connection between the two, there were few who regarded it as more than an idle assertion. It was not until a few years later, when Joule demonstrated this relation, and still later, when Carnot enunciated the principle of the reversibility of the heat engine, that the law of the correlation and conservation of forces received recognition. According to Carnot's principle, it was theoretically possible to convert mechanical work into heat and by utilizing that resulting heat perform the same amount of mechanical work again, thus completing the cycle. This having become an accepted dogma, it was not much of a step to conceive that other cycles might be possible. To my mind the greatest object lesson of modern times has been that furnished by the facility with which electricity—more especially in the form of alternating currents—lends itself to the extension of the radius of cyclic changes. To me the most interesting lessons of the World's Columbian Exposition were those which were taught by the exhibits showing a few of the possibilities in this line.



FIELD-MAGNETS WITH POLAR RING, IN THE GERMAN EXHIBIT.



A VIEW OF THE INTRAMURAL ELECTRIC RAILWAY.

When, in 1891, the experiment was tried of transmitting power derived from the falls of the Neckar to Frankfort by electrical means, crowds flocked to see the falls pumping water after their energy had passed through a cycle of six changes. To be sure, the problems of chief interest to engineers were those of insulation against high pressures and the practicability of the three-phased current in power transmissions, then first prominently brought forward, but the principle upon which these problems ultimately depended was that first enunciated by Joule and Carnot.

It will be remembered that in the Lauffen-Frankfort experiment some 300 horse-power were transmitted a distance of 108 miles at 30,000 volts with an efficiency in transmission of about 70 per cent. and utilized at the Frankfort exhibition in part in lighting a bank of lights and in pumping water for an artificial waterfall. This experiment was epoch-making and has lent an unusual interest to the methods there employed. One of the most interesting power exhibits at Chicago, therefore, was that of the Allgemeine Electricitäts-Gesellschaft, the company which built and installed the transmission plant above referred to. In this exhibit were shown all the parts involved in the experiment, including the three-phased generator, step-up and step-down transformers, and three-phased motors. The machines shown were not exact duplicates of those originally employed, but embraced such improvements as later experience had suggested.

The foreign displays of electrical apparatus were looked forward to by American electricians with the keenest interest, as it was hoped that they would abundantly illustrate electrical practice, so far as it might be said to be typical, of competing companies abroad, in order that a comparison might be drawn between their machinery and our own. These anticipations, so far as generators and motors were concerned, were only fulfilled partially by Germany alone. England showed absolutely nothing, and France only a few generators, alternating current and direct, which performed no functions of a useful or instructive nature.

The two great houses of Germany—Siemens & Halske and the Algemeine Electricitäts-Gesellschaft—had interesting though small displays. The latter was especially interesting, not only for the reason already assigned, but because it contained several features entirely new to this country. One of these novelties was the adoption of what has been termed the "polar ring" for the fields of direct-current motors and generators. This consists of a cylinder

of soft iron about an inch thick, enveloping the armature and connecting the pole-pieces of the field magnets. This was claimed to have advantages in prevention of sparking, for which purpose it was employed, which more than compensated for the magnetic short-circuiting which it must inevitably have produced.

This polar ring is strongly advocated by Dobrowolski, to whom I believe it is due, but it requires great effort on our part to believe the remedy is not worse than the disease. Certain types of field magnets have heretofore been so universally condemned by electricians simply because their shape has been such as to conduce to magnetic leakage that they have almost, if not quite, disappeared from the market. A deliberate short-circuiting of the magnetic field such as was illustrated in these machines was therefore astonishing, especially in view of the fact that sparking has been remedied in what would seem to be more rational and more economical ways. But *any* remedy is expensive that does not alleviate the disease, if one has to pay for the prescription, and I believe this is an expensive remedy, both because we pay for it in the lines of force short-circuited through the polar ring and because these machines *do* spark quite as much as well-constructed machines not employing the polar ring.

Another novelty in this exhibit which had real merit was the flexible coupling for directly connecting two shafts in approximate alignment, which consisted of two heavy iron disks, upon the face of one of which were a series of radial slots and upon the face of the other a similar series of brush-like rays of a number of thicknesses of thin sheet-iron, so arranged as to take into the slots on the opposite disk. Considerable play is allowed, permitting the two disks to gear easily, even if their shafts be perceptibly out of alignment, and the flexibility of the brushes is such as to take up the sudden strains, if moderate, or to permit them to slip a cog or two if excessive.

Siemens & Halske also showed three-phase motors and transformers. Of the latter there were two of 50,000 watts capacity each. In these air alone was used as insulation.

Until recently it has been urged by some practical men as an argument against the adoption of electricity in their business that, although it might accomplish some things better than agencies already in use, it was not sufficiently elastic to accomplish *all*, and that its adoption only meant an additional plant capable of doing one or two things a little better than existing plants, making of

electricity a luxury. This was undoubtedly true, and in no direction more so than in the field of mining. For this reason the application of electricity in mining has not kept pace with its applications in other industries.

The two largest electrical companies of America made displays side by side which must forever remove from the popular mind all idea of the lack of flexibility of electricity. The electrical exhibit at the World's Fair would have been a marked success had nothing else been shown than what were called "the transmission of power" schemes of the General Electric Company and of the Westinghouse Electric and Manufacturing Company. These two rivals presented each its own choice of methods—both well known to the electrical fraternity in each of their several parts, but neither of them ever before so completely illustrated on a working commercial scale. Additional significance was given to these two displays because it was generally believed that they represented between them, in all essentials, the system that would be employed in the Niagara Falls transmission-plant.

The General Electric Company followed the lines of the Frankfort-Lauffen experiment in so far as it employed the three-phase system, while the Westinghouse company employed the two-phase or Tesla system, but in each the most prominent feature was the flexibility of the system in hand. Each of these displays will be best illustrated by following the current from its point of entrance to the exhibit through its various transformations and translating devices which were selected so as to illustrate how, from a single source, energy could be transmitted and distributed on a large commercial scale for almost every conceivable practical use. Both of these exhibits assumed a waterfall as the source of energy, but they obtained their water-power in different ways. The General Electric Company employed a deep-mine triplex pump capable of raising water against a head of 650 feet, to furnish the water-power. This was operated by a 100 horse-power 220-volt direct-current motor, receiving current from Machinery Hall by the Edison three-wire system. The water from the pump was directed against the buckets of a Pelton water-wheel, which was directly connected with a 35-kilowatt three-phase generator, whence the currents passed to step-up transformers having a ratio of 20 to 1. They were thence transmitted at the higher potential on three No. 18 wires a short distance to what was called the Mining exhibit. Here they were transformed down again to 110 volts and carried to a

distributing switchboard whence lighting- and motor-circuits radiated. On one of the former a bank of incandescent lamps constituted the load ; on another, arc-lamps, and on a third, a series of small three-phased motors were operated, thus repeating all the links in the chain which bound Lauffen and Frankfort in the memorable experiments of 1891. The extreme potentials, long distance, and volume of power, however, were lacking.

The General Electric Company also showed both here and on the battle ship *Illinois* motor-transformers, the latter being fed from the Intramural railway trolley-wire, transforming the 500-volt current down to one of 80 volts. The secondary armature of this was compounded for the usual percentage of loss. As the current was to be used for lighting purposes, which required that its voltage be maintained constant between very narrow limits, it became a very pretty problem to compensate for the wide fluctuation in the primary. This was partially accomplished by commutating the field windings on the motor and further by inserting in parallel with the shunt winding of the generator a storage-battery which absorbed energy when the E. M. F. was too high, and gave it out when it was below normal.

The Westinghouse transmission-plant received its energy from two alternating currents in quadrature, derived from the two armatures of one of their 750-kilowatt generators in Machinery Hall. These currents at 2000 volts and 7200 alternations were transformed down to 200 volts in the building and then led to a 500-horse-power two-phase Tesla alternating current motor. Upon the same shaft, to simulate a prime mover, was a Pelton water-wheel, but this was merely a dummy operated by, instead of driving the motor. This latter, however, drove a 500-horse-power alternating-current generator. On one side of this generator, from four collecting rings, there were taken two alternating currents in quadrature with each other of about 4000 alternations and at a potential of 360 volts. On the other side was a direct-current commutator connected with the same winding, from which could be delivered a direct current at 500 volts. All three of these circuits were led to appropriate terminals on a switchboard for the distribution and control of their currents. By the alternating currents there was operated a 500-horse-power two-phase Tesla motor similar to the generator just described. This was also connected as a rotary transformer.

By means of special field connections this could be started as a

two-phase motor, and after it had gained its speed, by means of a switch, changed over to a self-exciting synchronous motor. As a motor it was employed to drive a Worthington pump and a 40-light Westinghouse alternating-current arc-light dynamo, and as a direct-current generator it furnished current at 500 volts to two 30-horse-power street-railway motors, to a 60-horse-power motor driving an Ingersoll-Sargeant air-compressor, and to a series of constant potential arc-lamps.

Another circuit from the switchboard was connected to a 60-horse power two-phase motor and transformer, which, receiving alternating current at 360 volts, delivered a direct current at 50 volts, which was used in operating a large Sbuckert search-light and which was suitable for electrolytic and other work. Still another circuit from the switchboard supplied current to a 60-horse-power two-phase Tesla motor of the synchronous type directly connected to a 45-kilowatt constant-potential alternator employed for incandescent lighting, and another circuit furnished current without further transformation to incandescent lamps. All of the transformations and all of the uses indicated in the above-mentioned applications were at different times, and when not incompatible with one another, simultaneously exhibited, and, being in every case on a commercial scale, constituted the crowning triumph of the electrical display. It was an object-lesson which must have satisfied those who had questioned the flexibility of the electrical method of transmission of power and transformation of energy. It was a realization of the theory of the correlation of forces such as neither Mayer nor Joule could have dreamed of when they first announced it.

But perhaps the part which electricity played in the transportation problem at the World's Fair came more nearly home to the masses. Within the enclosure there were three principal means of conveyance, viz.: the electric launches on the lagoons, the Intramural electric railway, extending around something more than three sides of the grounds, and the movable sidewalk, extending along the steamboat pier from the Casino to the further end. Subsidiary means of transportation were furnished by the three large traveling cranes, of 20 tons capacity each, in Machinery Hall, which ran the whole length of the building, and which, after having done duty in installing the heavy machinery, were pressed into service to give visitors a bird's-eye view of the great mechanical exhibit, the numerous elevators in the several buildings, and the

roller-chairs. All of these, except the last, were electrically propelled, and in the aggregate carried many millions of passengers.

The movable sidewalk was interesting as pointing a wide departure from established methods in transporting passengers. In this, a continuously moving carrying platform, supported upon and propelled by the periphery of the wheels of the trucks and therefore having double the speed of the latter, receives and discharges passengers while in motion by means of an intermediate slowly moving platform supported upon the axles of the trucks running upon an endless track. The relative speeds of the faster and slower platforms and the absolute speed of the latter are such as to render passage from one to the other, while motion is maintained, safe even for women and children. Since both platforms are continuous and run in closed paths, there is as much up hill as down hill and the path is therefore reduced to a plane. Since there is neither starting nor stopping, the element of the overcoming of inertia is likewise eliminated, and on theoretical grounds, at least, ideal economies should be maintained. Just what the economy was in this case can only be told when the final figures are published, but it will undoubtedly be large. In some careful experiments made by Frank J. Sprague some years ago on the Third-avenue Elevated railroad in New York, it was found that 83 per cent. of all the power utilized was consumed in overcoming gravity and the inertia of trains and that but 17 per cent. was required to maintain them in motion. It may be mentioned that the movable sidewalk was the most formidable competitor for the franchise which was finally granted to the Intramural railway, and that it has been seriously proposed as a solution of the congested transportation facilities in New York city, but it would appear to be of questionable availability for the latter purpose. The electric launches were a success financially, electrically, and popularly,—upon this all are agreed.*

Although the route pursued by the electric launches was almost an ideal one, bringing into direct communication with one another all the principal points of interest within the grounds, it was not used as a *convenience* by the masses, because of the exorbitant fares charged which made the use of the launches a luxury. In strong contrast with the launch route was that followed by the line of the Intramural railway. This led *from* nowhere *to* nowhere, and al-

* Some figures presented in the Department of "Electricity" this month give an idea of the work performed by these launches and of the cost.—THE EDITOR.

though the charges were fairly reasonable, no one thought of patronizing its cars for convenience. The concessionaries, however, were not responsible for the bad location, as they were obliged to content themselves with what they could get. That it carried without serious hitch or accident nearly six million passengers during the term of the Fair speaks volumes for the success of the experiment.

The General Electric Company, who under the name of the Western Dummy Company were the successful competitors for the franchise, have in the Intramural railway apparently solved in a satisfactory manner one of the burning questions of the day, viz. : electrical traction for elevated lines and others having their own right of way. Whether or not all of the technical and financial details have been satisfactorily solved, no one but the General Electric Company yet knows, but the public were satisfied with the service which was maintained without interruption, and this must be counted a long step in its favor.

From one point of view, the Intramural railway experiment is the most important that has ever been tried in the practical application of electricity. It has demonstrated to the public the entire practicability (from their point of view) of the application of electricity in large units to the traction problem. It has furnished to its projectors the first authentic data upon which to base future estimates, and if mistakes have been made it will enable them to correct them in future installations. In brief the system employed was as follows: Trains were made up of three trail cars and a motor car upon which latter were placed four motors—one to each axle. The method of control was what is known as the "series parallel," by which the four motors, each of 133 horse-power capacity, are thrown at starting in series of four, followed by a parallel arrangement of two in series and finally of all four in parallel. By this arrangement the required maximum torque at starting is obtained with a minimum flow of current and a more uniform consumption is maintained at all speeds. The current is carried to the motors by means of two overrunning trolley shoes running upon a third or trolley rail to one side of the track and is returned to the generator by means of the track and the iron girders of the elevated structure. A fourth rail, extending about three-fifths of the length of the structure and connected at frequent intervals with the trolley rail, does service as a feeder. The actual length of the road is 14,800 feet of double track and 1900 feet of single track, and in this dis-

tance grades of from 0.42 per cent. to 2 per cent. are encountered and numerous curves down to 100 feet radius.

All of the cars are 50 feet in length and weigh, the trailers 20 tons and the motor cars 30 tons, when filled with passengers. Thus it will be seen that the conditions met with in the elevated roads of New York and elsewhere were in all points fairly duplicated. The maximum number of trains in service was fifteen, and these were run at a five minutes headway.

The Intramural power-plant, which comprised by far the largest part of the generating apparatus intended for power purposes at the Fair, did double duty. First it served as an exhibit for the General Electric Company of their largest sized railway and power generators and the various methods in vogue of hanging the armature and of driving it. There were in all five enormous generators shown—one 500 kilowatts four pole generator, driven by belt, and one 250 kilowatts, six pole, one 400 kilowatts, twelve pole, one 750 kilowatts, twelve pole, and one 1500 kilowatts, 12-pole generator—all directly connected to various makes of engines. The last is the largest dynamo thus far constructed, but so rapidly are large units growing in favor that there are already several others exceeding this in output either under way or contracted for. The capacity of this plant was of course far in excess of the demands made upon it by the Intramural railway, so that the various generators took turn either singly or in multiple in supplying these wants.

The enormous outlay required for this magnificent exhibit precludes the possibility of its having made in dollars and cents an adequate return to the exhibitors. They evidently relied for reimbursement upon the experience and prestige it would give them in this hitherto practically untouched field of electric traction, and the renewed consideration which electricity is receiving in our larger centers of population on urban elevated and interurban routes gives promise that their confidence was not misplaced. For obvious reasons the General Electric Company have declined to make public the technical results of the experiment, but however much this may be regretted from a professional point of view, there are few who in their hearts will blame them.

WHAT CHEMISTRY OWES TO ENGINEERING.

By Joseph Torrey.

MOST of the so-called sciences have had their origin among schools and thinkers, pure and simple. As one traces their history he will find that they long remained, as at first, the property of the few; their influence was an intellectual rather than a commercial one, and their apparatus crude and imperfect. In the course of time, however, these retiring servants of mankind have been, one by one, drawn forth from their seclusion and enlisted in the great army which turns nature's resources into money. The history of chemistry is a somewhat peculiar one in this respect, for it has been longer in the field than any of the other sciences. In fact, its results were made use of long before we have any authentic record of its development as a pure science; this fact, however, is true in several other cases. For example, the manufacture of iron extends back beyond all *historical* record. The reduction of iron from its ores is a purely chemical process, though not an easy one to carry out in such a way as to obtain a useful product. The same is true, and more emphatically, of its conversion into steel. By what gropings and chance observations the bare facts necessary were discovered we can only surmise. At all events it seems to be quite evident that the credit for whatever success attended these early efforts, must be laid to engineering rather than to chemistry, for men were of necessity engineers before they were chemists. Instances such as this might be multiplied, but I doubt if the point would be any clearer than this one notable instance makes it.

In order to appreciate the relationship between engineering and chemistry it is necessary first to premise a few facts that are probably unfamiliar to those who are not chemists, but which must be understood fully in order to enable us to rightly apportion credit in any given case. Let us come back to iron-manufacture. In these days it is an easy matter for the chemist in his laboratory to take a small quantity—say 100 grains—of iron-ore and obtain from it practically all the iron it contains in a nearly

NOTE.—This article was suggested by a similar one, by Mr. Griswold, on "What Engineering Owes to Chemistry," which appeared in THE ENGINEERING MAGAZINE of November, 1892.—J. T.

pure state. In precisely the same way any one of the chemical manufacturing processes in use to-day—for example, the aniline, soda ash, or sulphuric-acid manufactures—can be carried on in chemical laboratories on the small scale, with better results than in the manufactories themselves; but every chemist of experience knows that it takes only a very slight increase in the scale of operations to make a vast difference in the product and the "yield" of that product, and even though the capacity of the apparatus be increased so as to make it possible to handle large amounts, say a pound or so, of material, it is invariably the case that only part of the difficulty is thus compassed. Small reactions and disturbing effects, not noticed on the small scale at all, suddenly rise up and demand attention. If heating is demanded, it may appear that uniformity and regularity of heating is more important than was first supposed. The unavoidable loss of material increases, and on all sides it appears that the whole matter must have a new thinking over.

Now when this second thinking over comes in order, it often appears that chemistry has done about all it can and that recourse must be had to what is really engineering, and not chemistry. If there is loss in transferring material, then some device must be thought out by which this transference can either be made more economically or avoided altogether. If the trouble is that materials do not get thoroughly mixed or that heating is not uniform throughout the mass, we must find some way of keeping our materials in agitation by some kind of a mechanical stress; or if it is a furnace process we are dealing with, it will be necessary to devise some way of charging the materials so as to secure uniformity of distribution. These and other similar problems having been solved, material can be handled in the laboratory on a moderate scale, provided the question of dollars and cents is not too prominent.

Let us take one step more, and come up to commercial application of our process, whatever it be. We are now concerned, not with grains of material, but with tons; and the sole question now is not "Can this product be produced?" but "Can it be produced profitably?" Let us see what this latter question means. It means that the plant must produce material the sale of which will cover the cost of production and pay dividends on the capital invested, besides insurance, taxes, etc. In order that this may be the case the apparatus must be planned so as to be as durable, simple, and easy to repair as possible; and if any part of it is particularly exposed to

rapid deterioration, arrangements must be made by which it can be readily removed and replaced by a new or newly repaired piece. The cost of production involves among other things the cost of moving material from one part of the plant to another. This cost must be a minimum. In almost every such process, moreover, fuel is used in large quantities, partly for heating materials, perhaps, and also for steam power. Most of the work done around the establishment must necessarily be of the nature of plain, unskilled labor, and acordingly things must be so planned and arranged that such labor will answer.

On the other hand, some problems arise,—sometimes the most serious ones in the whole collection,—which are chiefly chemical. For example, suppose we find it necessary to keep in agitation a large mass of material which happens to be such as to corrode iron rapidly. It is necessary to construct our vat of some other material, and the search for such material is often long and discouraging. Perhaps we find it necessary to keep our material at a dazzling white heat in lots of ten tons at a time in a furnace. We shall have many long and stern battles with that problem before it is solved. Here it is not only a question of chemistry. It involves full as much engineering. From this survey of the case it is evident, I think, that the minute we attempt to take any process, no matter how simple, out of the laboratory and make a commercial process of it, it becomes an engineering problem, and its successful consummation requires the exercise of the *engineering sense* rather than the *chemical sense.* From this point of view, if the question be asked 'What does chemistry owe to engineering?" it may be replied that in so far as chemistry has been successfully applied in the arts the credit belongs chiefly to engineering.

I shall confine myself to two cases which illustrate this. There are many others, but in order to see fully the point in each case it would be necessary to go into details more than space will permit.

Let us first consider, then, the manufacture of pig iron in the blast-furnace. The problem is to obtain metallic iron from some available iron "ore," that is, from some naturally occurring iron compound which is abundant enough and rich enough in iron to be worked on a commercial scale with profit. The chemical fact with which we start is that the principal ores of iron available are reduced to metallic iron by heating in contact with some form of carbon, such as charcoal, coke, or coal. In practice, even on a relatively small scale, it is found necessary to add limestone to the

charge, because it has the power of forming a fusible *slag* with the impurities contained in the ore and fuel.

Such is the bare outline of this great manufacture. It is simplicity itself, and yet the development of its resources as a manufacturing process has been one of the great achievements of recent years. The reduction of the ore to metallic iron is carried out in so called blast-furnaces. These are of colossal dimensions, being often over eighty feet high and twenty feet in diameter at the widest part, and sometimes having an output of over two hundred tons of pig-iron in twenty-four hours. The proper consideration of the blast-furnace itself would take volumes. To point out even superficially the nicety of engineering involved in its construction, and the "ways that are dark and tricks that are vain" of which it is capable when in operation, would be an almost endless task. We will adhere to the original plan and only point out how it has developed from crude beginnings to its present state. To begin with, it became evident that the process of making iron in the furnace must be continuous. That is, it would not pay to fill up the furnace with ore, fuel, and limestone, melt down that charge, draw off the iron, and then fill up again. In the first place, it would prove wasteful of fuel. In the second place, it would, owing to the frequent heating and cooling, be very trying to the furnace-walls, causing cracks and distortions, and, taken all in all, the cost of producing metal in large quantities would be too great. The problems presented here are purely engineering ones. Again, it was found necessary to supply forced draught; and the history of the various contrivances that have been employed as blowing engines would form material for another large volume.

All this time the top of the furnace had been open and all the waste gases allowed to burn there. Soon it was seen that these gases might be carried off and burned, and the heat utilized. The first use that was made of the heat thus saved was in heating up the air which was to be blown into the furnace by the blowing engines. Then the general shape and arrangement of things around the furnace underwent a change. Instead of being built of fire-brick, the "stack" was sheathed with boiler-plate, making a neater and more compact structure. The means of getting materials to the top for charging were improved, and ingenious methods were devised for charging the ore, fuel, etc., into the furnace without waste of time or gas.

In all these cases engineering has been the important factor.

Meanwhile chemistry has been at work in other ways. Without careful analyses of ore, fuel, limestone, and the finished product, the pig-iron as well as the slag, it is extremely difficult to properly proportion charges so as to get a uniform product and good economy of production; and of late years the chemical laboratory is a fixture in every well appointed blast furnace plant. With this hasty survey let us pass on to look for a moment at another chemical process which has been commercialized on fully as heroic a scale as the one just considered, and which is the greatest existing instance of the dependence of chemistry upon engineering in its commercial application. I allude to the Bessemer process for making steel.

The principle is extremely simple. Steel contains less carbon than cast iron and also contains some manganese. Now the Bessemer process starts with cast-iron, and first removes all carbon from it; then adds the right amount, and the necessary amount of manganese. The product is steel. Melted cast-iron (perhaps ten tons) is poured into a huge egg-shaped vessel which hangs on trunnions with its large end down and is called a *converter*. The bottom of the converter is so arranged that air can be forced in through small holes and made to bubble up through the melted iron. The oxygen of the air then seizes on the carbon in the iron and burns it just as the coal is burnt in a stove, only more furiously. The time taken to burn out the carbon varies—according to the amount of iron *blown* and the quality of the iron—from 7 or 8 to 15 minutes. During the process flame shoots out of the opening at the top of the converter, short and dull at first, but long and brilliant toward the last. When all the carbon is gone the flame suddenly *drops*, *i. e.*, shortens and grows dull. The converter is now turned on its trunnions till its mouth comes down, so that there can be poured in a certain amount of an iron which contains the required amounts of carbon and manganese. After standing a few minutes the charge of fluid steel is poured out into a great ladle handled by a crane, from which it is run into ingots which are usually carried off to another part of the works, reheated somewhat, and rolled into rails.

Simple as all this may seem, it required years of unsuccessful and discouraging work to bring it to a point where it was commercially successful. Chemistry has done its part. Only by careful analysis of materials and product has it been possible to follow clews which led to the production of a marketable product; but on the other

hand, the engineering problems presented have been simply stupendous and have in their solution drawn out the greatest mechanical engineering of the present century. Any one who reads, as every young engineer should again and again, the life of Alexander L. Holley, will find most of it there.

In the first place, the process must be continuous. This involves first of all the question of a suitable converter lining. The temperature which it has to stand is enormously high, and this, combined with the washing of the melted metal and slag against the sides, demands an extremly durable and manageable material. The bottom linings in the early days gave out very rapidly and the process of cooling down and repairing this lining was a tedious and wasteful one. Holley solved this problem in his usual brilliant fashion by making the converter bottoms removable and planning so that, while one bottom was in service, another should be in process of repair. The change only occupies a few minutes, and as the new boiler is thoroughly dried and heated by a gas flame before being put on, there is practically no trouble from *chilling*.

But after all the greatest problems came up in connection with the general arrangement of the whole plant in such a way that materials could be handled with the greatest ease and expedition. The complete manner in which they have been met and solved is best appreciated by a visit to some large modern Bessemer works such as that of the Bethlehem (Pa.) Iron Company, or the Illinois Steel Company's South Chicago plant. In such an establishment there is hardly a single piece of machinery from converter to ingot mold which is out of employment more than a few minutes at a time. From the time the iron enters the top of the blast furnace as ore, till it emerges at the end of the "finishing train" as a rail, it is in almost continuous motion.

It goes without saying that many others of the great modern industries which are essentially chemical in principle would, on study, show the same fact as the two we have considered. It seems to me that the most important conclusion to be drawn is that young men who are studying chemistry with a view to entering on industrial work had better take occasion to acquire some engineering knowledge. One of the best ways to do this is to see as much good engineering work as possible, and not only see it, but *think about it*. The great defect in our modern schools is that students have so little opportunity to meditate.

AMERICAN AND FOREIGN PATENT SYSTEMS.

By Casper L. Redfield.

IN the early history of nations, despotic monarchs were wont to grant monopolies and exclusive privileges, known as patents, to certain individuals. These grants were not made out of any sense of justice and right, but simply as royal favors to certain court favorites. The first English parliament under James I. limited the grant of such exclusive privileges to cases of invention, and thus laid the foundation for the patent laws that are now in force in various countries.

The patent laws of the United States have their origin in the constitution, which gives to Congress the power to promote the progress of science and the useful arts, by securing to inventors for limited times the exclusive right to their respective inventions. Acting under this power Congress enacted the first patent law on April 10, 1790, since which various other laws have been enacted, the most notable and comprehensive of which are the laws of 1836 and 1870. The regulations under which United States patents are obtained and controlled may be classified under three heads :

First, laws enacted by Congress.

Second, interpretations put upon these laws by the courts,—or "court made laws" as they are sometimes called.

Third, rules made by the Patent Office.

While these laws, rules, and regulations are for the most part liberal to the inventor, and better than those of any other country, still there are many points where improvements could be made, the results of which would be increased liberality to the inventor and increased benefit to the general public.

The spirit and intent of all patent law should be to secure, for a limited period, to the actual inventor the thing that he actually invents, to the end that individuals may be induced to make new improvements that shall ultimately become public property. As the making and perfecting of inventions is a costly and somewhat hazardous undertaking, that law is best which properly protects an invention at the least cost and trouble to the inventor. Under the laws of most, if not all, foreign countries, a patent is simply a government certificate to the effect that a certain individual claims to have invented certain new and useful improve-

ments, properly described, and that he has the right to use the machinery of the law to prevent others from making and using his actual improvements. In the United States this certificate is the same, except that it has the added force of having been passed upon by certain government officials, called "examiners," who have carefully scrutinized the application and have found no reason why the inventor is not entitled to that which he claims. As the courts will not protect an inventor in the use of things which were not first original with him, and as the multiplicity of improvements makes it impossible for one person to know all that has been done, it will be seen that the judgment passed by an individual who has exceptional opportunities for finding out what has been done in any particular art is of material advantage, not only to the public, by preventing it from being imposed upon by spurious patents, but also to the inventor, by preventing him from wasting time, money, and energy on old things under the belief that they are novel.

The United States supreme court has said: "A patentee has two rights, first, to make, use and sell his invention, and second, to prevent others from making, using or selling it." Also, "as patents are procured *ex parte*, the public is not bound by them, but the patentees are."

From these decisions of the court, and from the preceding remarks, it is evident that the actual inventor may invoke the law to protect him in the exclusive use of the thing that he actually invents. Before he can do this, however, he must have a patent that properly sets forth his invention, because the courts will not take cognizance of what his real invention is, but of what his patent says the invention is. Furthermore, the statement of what the invention is, is not to be found in the drawings, nor in the description that occupies the bulk of the space in patent papers, but in claims that are appended to the specification, and to the statement made in these claims the patentee will be strictly held.

It is therefore of the utmost importance to the inventor that the person who writes these claims should fully understand what is the spirit and essence of the invention, and be able to state it in clear and unmistakable language. How illy this is now done is shown by the fact that probably in not more than one case in ten, and possibly in not more than one in fifty, do the claims of a patent set forth clearly and succinctly the whole of the real invention. This failure to express the invention clearly and completely is due to (1) the

lack of knowledge of the exact state of the art, (2) the failure of the attorney to fully comprehend the scope of the invention, or (3) the inability of the inventor to properly explain his ideas.

Not only is an imperfect patent detrimental to the interests of the inventor, but it is also detrimental to the interests of the public. Every patent that is issued and fails from any cause whatever to be of a benefit to the patentee, discourages some other inventor; and every patent that is successful for a time only to be ultimately declared void or nonoperative by the courts, discourages capital from assisting other and meritorious inventions. Many valuable improvements are, from these causes, lost to the world until other inventors reproduce them, perhaps only to be lost again in the same way.

Improvements in the laws relating to patents should be along such lines as will best remedy these defects, to the end that, when a patent is once issued by the government, the owner may have something tangible and real,—something about which there is a reasonable degree of certainty that he can protect and maintain it. There is one class of individuals who would carry this to the extreme of having the government guarantee absolutely the validity of every patent issued, while there is another class who would have the government, on application, issue a patent to anybody for any thing without any questions whatever. In neither of these propositions can I concur. In the first case, absolute guarantee would negative the fundamental principle that exclusive rights are to be granted only to the first and original inventor, for the reason that, while there may be a moral certainty that the invention was never before known and used, there always remains the chance that it ultimately may be shown that some one else has a prior claim. The world of inventors is altogether too large to make absolute guarantee a possibility.

The second manner of issuing patents is that adopted by countries other than the United States, and which marks the chief difference between the American and foreign patent systems. If we should follow this free and easy method of issuing patents, a patent would have no more force and value than the unsupported statement of any unknown person. Such patents would have to win the support of capital by smooth and seductive talk rather than by merit,—a condition of things that would put the honest inventor of a valuable improvement at an immense disadvantage. On the other hand, if a patent represents an actual improvement, and if

there is a moral certainty, amounting almost to an absolute one, that the owner of the patent is also owner of the improvement it represents, then the inventor, no matter how humble his position in life, can go with confidence to the capitalist, and the capitalist will receive him respectfully, well knowing that he represents some thing of value, and perhaps of great value.

To bring about results that will tend to eliminate worthless patents and also to enhance the face value of those issued in the future, we must attack individually the defects as they exist in the law. In the first place, it is desirable that patents be not issued for devices that are old, and that matters to which the inventor is not obviously entitled should be rigorously excluded from the claims. This cannot be done unless the state of the art to which the invention pertains is fully and accurately known. To this end I would recommend that the Patent Office be supplied with additional data, including books, periodicals, catalogues, circulars, and all other publications relating to the various classifications of inventions, and that the force of examiners be increased sufficiently to enable them to refer to these as well as to the patents of record. Also, that the examiners, in addition to citing references that bear directly upon the claims submitted, be required to cite other patents or publications that show an advanced or special state of the art. As these things are certain to come up at some time during the life of a successful patent, it is the part of wisdom that cognizance be taken of them at the outset, so that time, money, and labor may not be uselessly expended. As the inventors pay all the expenses of the Patent Office, the additional force here recommended could not reasonably be objected to, especially as the results attained would be fully as advantageous to the public as to the inventors themselves.

In the second place, attorneys who are admitted to practice before the Patent Office should be only such as are competent to clearly understand an invention and to set it forth in concise language. At the present time, in the United States, any one is at liberty to act as an attorney in patent applications, and many cases are prepared by persons totally unfit for the service. This is often the case when patents are obtained on what is known as the "bureau system." In offices where this is practiced, applications are prepared by a force of clerks whose only object is to obtain an allowance and issue of the patent without respect to the nature of the claims that go to make up the patent. Such practices

should be abolished, and no one should be permitted to act as a patent solicitor who has not demonstrated, by passing a satisfactory examination, that he is competent to understand and properly explain the mechanical principles that go to make up inventions. To still further insure that each patent issued be prepared in the best possible manner, each examiner in the Patent Office should be instructed to suggest certain claims, whenever it became obvious to him that the inventor or his attorney was overlooking some important matters that should be incorporated.

With these two improvements carried out in a proper manner, patents would rise considerably in character and commercial value, capital would be less shy in embarking upon enterprises based on patented improvements, and many valuable inventions would be saved from an untimely death.

It does not follow that all the improvements in the patent laws should be in the line of increased liberality to the inventor. Some should be made in the interest of the general public. One need may be pointed out particularly that relates to the duration of the patent and the time occupied between filing and issuing. The majority of inventors are anxious to have a patent issued as quickly as possible. Old hands at the business, and especially corporations, often take an exactly opposite course, and delay issue as long as possible. These delays are deliberately brought about, sometimes for the purpose of secrecy, sometimes to give time for the preparation of other cases, and sometimes for the purpose of prolonging the life of the invention. The first two reasons for delay are legitimate, but the last is not, hence it is an abuse of a privilege for the sake of private gain. To show to what extent this abuse has sometimes been carried, it is only necessary to state that in one case an application was kept pending for fourteen years, thus giving the owners a practical monopoly for thirty-one years, or nearly double the time contemplated by law. How long a patent might be kept pending in the Patent Office by skilful or unscrupulous attorneys, is a matter of doubt. Possibly the larger part of a century might be consumed by dilatory tactics if there was any object in it, and no new law intervened.

To do away with this abuse, some writers have advocated dating patents on the day of filing and not the day of issue, as is the case in foreign countries. To this change I am opposed, because under our present system, or any system that I would advocate, the inventor has certain legal and equitable rights that would become

forfeited if a patent took the date of filing, and because the abuse can be corrected by simply removing the incentive, without at all curtailing the rights and privileges now enjoyed. As the sole object of extending the time that elapses between the date of filing and the date of issue, beyond what is necessary to protect the interests of the inventor, is that of maintaining a longer control of the invention, the remedy is a proviso in the law that, while a patent should have a life of seventeen years from the date of issue, no patent should extend to more than a certain number of years beyond the date of filing. This term I would set at twenty years, thus giving the inventor three years in which to prepare his application for issue without having time run against the life of the patent. The three years provided in which to prepare the application for issue is ample time for the great majority of cases. Where more time is consumed for any reason it should run against the life of the patent. I believe the corrective will fully remove the abuse.

In most other countries annual taxes must be paid on each patent, and there are requirements compelling the manufacture or use of the invention within prescribed limits of time. Onerous exactions of this kind tend only to discourage and restrict invention, and should have no part in the laws of the country where the constitution gives Congress the power to "promote the progress of science and useful arts." It is true that a practice has grown up of buying-in competing patents and pigeon-holing them to remove competition. Requirements as to taxes and workings would find their only justification in attacks upon such cases, but as this practice is indulged in only by wealthy corporations, the remedy would fail of its effect, while many poor but worthy inventors would be wiped out of existence.

Patent law is a thing somewhat apart from ordinary law. This is due largely to the fact that to be a successful patent lawyer or solicitor requires a knowledge of mechanics. It follows, therefore, that patent attorneys are specialists, that the court which sits in judgment upon patents should be composed of specialists, and that the Congress which makes the laws relating to patents should have the advice and assistance of specialists.

Under a patent law that is to-day more liberal and beneficent than that of any other country, more inventions have been made in the United States than have been made by any other people, and we have established more manufactories based upon inventions

than can be found in any other land. Under a law still more wise in its provisions, inventions will increase in number and in value, foreign countries will pay us tribute for their use, manufactories will multiply, and general prosperity will abound. Casting my vision into the distant future, I can see a time when the very existence of the human race may depend upon some invention not yet made and not now dreamed of. It is therefore not well for us to harass and discourage the inventor by petty exactions of the law, but rather should the strong arm of the law reach forth to lift up, support, and encourage the inventor in his good work, that we and our posterity may be benefited thereby.

ELECTRICITY

Conducted by Franklin L. Pope.

THE Intramural railway may fairly be considered to have been one of the principal electrical successes of the World's Columbian Exposition. No less than 6,000,000 passengers were transported during the continuance of the fair, and not a single casualty of any kind occurred. On "Chicago day" the number of passengers reached its maximum of 125,000. It is said that the results of operation, which at the time of this writing have not been made public, will conclusively demonstrate the economy as well as the convenience of this method of operating rapid-transit lines. It is not likely that the change from steam to electricity will be made at present on any of the existing elevated lines in our large cities, inasmuch as it yet remains to be proved that the saving in cost of operation would be sufficient to justify the enormous expense of the necessary alterations, while on the other hand it is certain that no material increase could be effected in the carrying capacity of the trains. But in all the new lines about to be established, the question whether they shall be equipped with steam or with electricity is a most important one, and one not to be decided except after the most serious consideration. The full returns of the operations of the Intramural railway, when published, ought to throw a great deal of much needed light on this troublesome problem.

THE Liverpool overhead electric railway is equipped with an ingenious system of automatic electric signals, which, as far as we are aware, are the first which have been operated in Great Britain with wholly satisfactory results. A section of one of the British main lines is now to be equipped with electrically operated signals, switches, and crossings, controlled by small hand-levers in the signal cabins. The actual movement of the signal-arms and switches in the system is to be effected by the direct action of large long-range electromagnets energized by a strong dynamo current.

A LARGE contract for electrical machinery for the Niagara plant has been awarded to the Westinghouse Company, of Pittsburgh. The system which has been adopted is known as the Tesla polyphase. The present contract calls for three 5000-horse-power generators, with a corresponding equipment of motors, switches, etc. The rotating fields are carried on the upper ends of vertical shafts, and are thus coupled direct to the turbines. The upward pressure of the water supports the entire weight of the turbines, shafts, and rotating parts of the generators, thus doing away with nearly all the step-friction. The electromotive force of the dynamos will be from 2000 to 2400 volts, which will be raised and lowered by transformers at different points as required. The system adopted would seem to provide for every possible requirement of an electric service, either in the way of illumination or power.

IT is becoming very evident that some additional safeguards are necessary in the electric street-car service. Not to go back more than three months, there have been two runaways of electric cars on steep grades, in which over forty passengers have been more or less injured; five of them fatally. Four or five collisions of cars have occurred, in which nearly twenty persons have been injured, and at least three killed. Two or three instances have also occurred of street-cars having been struck by locomotives at grade-crossings. Any one who will take the trouble to follow the monthly reports of railroad accidents, as published

for instance in the *Railroad Gazette*, will soon be convinced that the reckless construction of electric lines across steam lines at grade, has introduced a new and very serious danger to the traveling public. President Clark of the New York, New Haven and Hartford railroad, in his annual report for the current year, says that "if the public exigency requires those roads to cross steam-roads, it should first compel a separation of grades under the operation of law." The *Railroad Gazette* pertinently observes that the electric railroads will generally be built in sections of the country which have already reached such a development as to justify restrictions upon crossings at grade, and that now, at the inception of what is bound to become a vast system of electric cable railroads, is the proper time to institute proper public control of crossings. The *Gazette* points out that the danger of collision at grade-crossings is greatly enhanced by the circumstance that the number of trains on the electric road, for a given number of passengers, is necessarily much greater than on the steam road.

THE *Electrical World* directs timely attention to a fact very familiar to engineers, that of all branches of engineering, there is scarcely one which calls for the exercise of more common-sense and good judgment, or in which the services of a competent engineer for the preliminary studies is more vitally necessary, than that of designing a combined water-power and electric transmission plant. There is a popular impression that water-power does not cost anything, but this is decidedly not the case. The matter certainly should not be left, as it often is, to the judgment of the selling agent of an electrical manufacturing concern, whose eagerness to effect a sale of the necessary machinary, and to pocket the commission thereunto appertaining, is liable, perhaps, to bias his opinions.

THE London, Brighton and South Coast railway of England has thirty of its trains lighted by electricity, and is now about to equip a number of additional trains. It is said that about 15 per cent. more work can be got out of an electrically-lighted than of a gas-lighted train, which makes a saving in first cost of about $225,000, as 85 electrically-lighted trains can do the work of 100 gas-lighted trains.

IT is stated that the trustees of the Brooklyn bridge are considering the feasibility of substituting electricity for steam in the propulsion of the cars. It is probable that the terminal switching, at least, might be performed advantageously in this manner.

A FEW years ago the process of electric tanning, which is now being extensively used in Europe, was presented to some of the leading tannery proprietors in this country, and was condemned by them on the ground that, even if the process possessed all the advantages claimed for it in the way of expediting the production without injury to the product, there would be no money in it. Now it is announced that the largest tannery in Switzerland is to be reconstructed and enlarged by means of an electric process.

THE plan of increasing the transmitting power of a magneto-telephone by making use of a plurality of diaphragms coupled to a plurality of generating devices, has been invented and reinvented a great many times within the past fifteen years, but practical tests had invariably demonstrated that one diaphragm was as good as a dozen, for all practical purposes. Recently, an inventor with a little better head than most of the others, bethought himself that the trouble might possibly be that the several diaphragms not only did not vibrate in exact unison, but that they more or less worked against each other. So he coupled several diaphragms together by means of a simple mechanical contrivance, with results that are certainly quite surprising. The volume of sound appears to be increased many fold, and when used as a receiver for the standard telephone transmitter, can be heard and understood several feet away. For private lines, this would appear to be a most admirable instrument, if the mechanical attachments

do not give trouble, which indeed there is no particular reason to expect.

AN electrically-operated typewriter has been for some time in use in Boston, which is so arranged that it may not only be used in the ordinary manner for office correspondence and copying, but may be electrically connected with a similar instrument at a distance, so that a copy of the work may be automatically reproduced thereon, even in the absence of an attendant. Such a machine apparently possesses great possibilities of future usefulness.

PROFESSOR GEORGE FORBES, at the International Electrical Congress, said that one of the most important points now to be considered by electrical engineers is the commutation of the alternating into the direct current. He remarked that every advocate of the continuous current, —and it has had, he thought, some very bigoted advocates,—would have been convinced in favor of the alternating current dynamo, if he could have been assured that a commutator could be placed at the far end of the line instead of at the power station.

IT is stated that there are now in the United States more than 300 mining companies making use in their operations of electricity for light and power. About one-third of the gross amount of copper refined in this country is now treated by electrolytic processes.

THE news of the victory of the *Vigilant* in the international yacht race was received in Glasgow within 30 seconds after she crossed the finish line in New York harbor. The Commercial Cable Company transmitted the despatch.

IN a recent number of this Magazine reference was made in this Department to a conduit system of electrical distribution for street-railway service which was being experimented with at Coney Island, with very promising results. It is well known that the principal difficulty in a system of this kind is that of preserving an effective insulation. A series of careful measurements executed by a well-known electrician on a section of 75 feet in length of the Coney Island conduit, which had been completely filled with water, showed a loss of current equal to only 1 horse-power for five miles. A similar experiment made with the car connections submerged, showed that the loss was approximately equal to one-thirteenth of the power required to propel the car. These conditions are apparently much more unfavorable than any which would be likely to arise in practical work. A system that can show such results as this is certainly worthy of a trial under actual conditions of service. If it is practicable to banish the overhead wires from the streets of large cities like Boston and Brooklyn, it ought to be done. But whether it is practicable or not, is one of the things which yet remain to be demonstrated.

ONE of the most recent electrical power-transmission plants in Switzerland presents features of novelty and interest. An average of 350 horse-power is transmitted a distance of about eighteen miles and is employed to operate a paper-mill. Two direct-current dynamos are connected in series, giving a current of 43 amperes at an aggregate potential of 6000 volts. The line wires are of copper 0.28 inch in diameter, and are strung overhead on porcelain insulators, affixed to poles thirty feet in height.

AN admirable example of the variance which is occasionally found to exist between law and common-sense, is that of a recent decision of the corporation counsel of the city of New York, in which he held that the Broadway cable railroad cannot be permitted to lay a wire in its own conduit for the purpose of signalling to the power-house to stop the cable in the event of an accident on the line, because the subway company has been invested with the exclusive right to lay wires in the streets of the city. The ultimate result of this prohibition will probably be a serious disaster, in which a car will run amuck the whole length of Broadway, carrying devastation in its path.

A COMPLETE system of toll telephone lines is now under construction by the British post-office, intended to reach every town in the kingdom of any commercial importance. A central toll-line exchange is to be established at Leeds, where the switching will be done.

A SYSTEM of electrically-controlled clocks has been arranged in Berlin, in connection with the electric-light and -power service. Once each day, at an hour when few lamps are in use, a momentary diminution of pressure in the mains, of about 10 volts, winds and sets the clocks, which are disconnected from the circuit the rest of the time.

THE reports of the working of the City and South London electric railway are very satisfactory. It appears that, while both the mileage and traffic have considerably increased over last year, the operating expenses are actually less. The cost of power generation and locomotives, which was at first 18 cents per train-mile, and 15.4 cents last year, has now been brought down to less than 13 cents.

IT was remarked in this Department last month that it was to be regretted that the electrical exhibitors at the World's Fair had in so many instances neglected to place some person in charge who was capable of giving an intelligible account of their exhibit. But it seems that they have in some instances been guilty of even greater folly. If any of them have failed to receive the award to which the merits of their exhibit entitled them, it is suggested that they ask themselves if the person selected to present the merits of the article to the judges was nothing more than a glib-tongued salesman, who although entirely competent to talk the tribunal deaf, dumb, and blind, was utterly incapable of giving an intelligible reply to the simplest question of a technical character. It is not easy to compute the aggregate amount of damage which has been inflicted upon the electrical interests of this country by apostles of this type, whose zeal (for a commission) is in most cases wholly untempered by discretion.

AT the Milwaukee railway convention of the American Street Association, an interesting paper on the heating and lighting of street-cars was read by G. F. Greenwood. Mr. Greenwood, speaking of the problem of heating by electricity, said that the cost of installing four heaters in a car, with regulating switches and appliances, ranged from $35 to $45, and that the expense for electricity varied from 32 cents per car per day, in moderately cold, to 81 cents in severely cold weather. He estimated depreciation and repairs at 5 cents per car per day. Estimating that a car requires to be lighted an average of eight hours per day, the cost of the five incandescent lights usually required footed up at 4 cents per car per day.

A NOTE appeared in the October number of this Magazine, criticising the primitive character of the arrangements for telephone service in connection with the new cable recently laid between Ireland and Scotland by the British post-office. We are glad to be authoritatively informed that our strictures were based on a misapprehension of the facts, and that the cable is designed to form part of a comprehensive scheme of intercommunication, in which ample provision is to be made for direct conversation between any two subscribers in any part of the United Kingdom.

REFERENCE was recently made in these notes to a newly-discovered process of electro-deposition, in which the application of the plating mixture by means of a brush, as in painting, was thought to render it peculiarly well adapted to the plating of the bottom of iron ships with copper. It is now announced that a plan has been devised by which the ordinary process of electro-plating may be applied to the same purpose. A flexible bath is employed, which is secured to the skin of the vessel by magnetic or other means, so as to bring the solution in direct contact with a portion of the surface, the bath itself constituting the positive electrode, and the

metal of the ship the negative. It has been found that a current of between 7 and 8 amperes per square foot at a potential of 1.5 volts, suffices to deposit a perfectly uniform, smooth, and adherent coating of copper to the surface of the vessel. A single deposit of sufficient thickness may be formed in about 72 hours. Of course, by employing a sufficiently large battery of dynamos, the plating process may be carried on simultaneously at any required number of places upon the ship. The quantity of copper required to coat the bottom of a ship 400 feet long and drawing 20 feet of water, is estimated at about 55,000 lbs.

AN insulated wire has been invented by an old and experienced electrician in the employ of the transatlantic cable companies, which appears to combine the impermeability and moisture-resisting qualities of the gums with the cheapness and convenience of the fibers which have hitherto been so largely employed for this purpose. It only awaits the invention of a really good insulated wire of this character, to bring about one of the most important reforms now needed in the telegraphic service,—that of the establishment of a sufficient number of underground trunk lines between our principal commercial cities. But for the necessarily high cost of wires covered with india-rubber and gutta-percha, and the inherent weak points of the fiber-covered wires, with which latter electricians are but too familiar, it is probable that something of the kind would have been undertaken before this time. We are always gratified whenever any advance is made in the art which promises to aid in bringing about this most desirable consummation.

THE application of the storage-battery to the propulsion of street-railway cars is being again tested on a large scale, this time on the Second-avenue line in New York city, and under conditions which seem likely to determine, for the present at least, whether the system is or is not a commercially practicable one. The work is being carried on in the most thorough and systematic manner, under the supervision of skilful and experienced electrical engineers, and great pains are being taken to determine what is in fact the vital point of the whole problem, viz., the actual cost of operation. The question is no longer merely one of practicability, for it is admitted that on lines with moderate grades, not too much obstructed with snow in winter, storage-battery traction may be depended upon to perform the service required. Thus far the figures of the Second-avenue line, with only six cars in operation, show that the cost of power, including everything properly belonging under that head, is 9.32 cents per car-mile. Horse traction is usually reckoned at from 10 to 11 cents per car-mile.

CONSIDERABLE surprise has been expressed at the statement, made at the International Electrical Congress at Chicago in August by a prominent California engineer, that in his state the transmission of power by electricity, up to date, had practically been a failure,—a surprise which has not been lessened by the fact that no one seems disposed to controvert the assertion. In a letter to the *Electrical Engineer* the author of the statement explains that the electric company which obtained an important contract sent out a thoroughly capable man to secure it, but unwisely entrusted to an incapable subordinate the work of actually superintending the installation. The power-house of the plant in question, it seems, is in a situation which is inaccessible during nearly half the year, and after a few days of not too successful operation, the field-coils of the generator were burned out, and other accidents which might have easily been avoided were permitted to occur, with the result of probably postponing the successful operation of the plant for a year. The writer adds that investigation has shown that there was no inherent defect in the system employed, and that the failure was directly attributable to a lack of careful and intelligent supervision during the erection of the plant.

THE new North End railway station in

Boston is to be provided with an electrical plant of 1100 horse power capacity. There will be some 4000 incandescent lights and 300 arcs, besides which the drawbridges, turntables, elevators, coal-handling machinery, etc., will all be operated by electric motors. It is expected that the work will be completed before winter.

THE record of the work of the electrically-propelled launches at the World's Fair shows that from April 13 to October 1, 1893, the 54 boats in service made 56,207 trips, and ran 168,621 miles, the average daily run of each being 25.57 miles. A total of 801,000 passengers were carried between May 1 and October 1. The average cost of electricity per launch per day at 3 cents per electric horse power, was 55.5 cents, and the total cost for electricity, repairs, renewals, inspection, and labor, exclusive of office expenses, was $1.48 per launch per day or 5⅞ cents per mile run. For a novel enterprise, carried out under many unfavorable conditions, it must be said that this is a most creditable showing.

A WRITER in the *Electrical Engineer* makes some sensible and pertinent observations in relation to the numerous accidents from electric street-railway cars which are almost daily reported in the newspapers. The blame of these casualties is invariably laid to electricity, and specifically to what the reporters stigmatize as the "deadly trolley," but as a matter of fact, neither electricity nor the trolley have anything to do with the actual source of the trouble. An analysis of the causes of accidents shows that the real difficulty in nine cases out of ten is lack of brake-power. "Electricity"—says this writer—"is the greatest force in nature, and is moreover, the most subordinate to control. Why then have we not, in an electrically propelled car, the safe and effective power to arrest its momentum and avoid accidents? The answer is, imperfect application." In conclusion, he suggests that the present evil is directly chargeable to the disposition of the manufacturers of electrical machinery to "let well enough alone." The criticisms of the newspapers would certainly be much more efficacious, if aimed at these manufacturers rather than at the helpless and innocent motor-man, who, like the apocryphal organist of the Leadville church, no doubt "does the best he can."

AN immense water-power plant is being erected in Sweden for the electrical production of chlorate of potash, to be used in the manufacture of friction matches.

EVERY prominent establishment engaged in the business of making and selling turbines publishes a book containing an elaborate set of tables, which profess to give the horse-power, quantity of water consumed, and speed of revolution for each size of the maker's wheel under various heads. Electrical engineers who have had occasion to fit up transmission plants to be operated by water-power, have discovered by sad experience that in many cases these tables are, to put it mildly, a snare and a delusion. It may be possible to "monkey" with a friction dynamometer so as to get peculiar results, especially in testing large powers, but when a turbine is harnessed to a dynamo, a good voltmeter and ammeter will tell the exact truth as to the effective horse-power every time, without fear or favor. The electric test has demonstrated that some of the most extensively used and most extensively bepuffed turbines fall woefully below the pretentious "guarantees" of their builders, not merely in commercial "efficiency," which is often a comparatively unimportant matter, but in speed and horse-power under a given head and with a given quantity of water. If the electric method of measuring water-power succeeds in dispelling some of the vociferous humbug in the turbine business, it will have performed an important service to the manufacturers of the United States.

ARCHITECTURE

Conducted by Barr Ferree.

THE *Architectural Review*, in replying to some comments made in these pages a few months ago on its beliefs and ideas, takes occasion to reduce its philosophy to the form of a Creed, puts it—as it blandly states—in primary form, in order—as we infer—to bring it within the range of our understanding. We highly appreciate the good intentions of our valuable contemporary, and trust that others than ourselves may have profited by the estimate it has formed of our intellectual status. But, alas and alack! this concentration of the Boston mind is not yet sufficiently simple for our poor New York understanding. The *Review* starts out with the statement that it believes "that architecture is an art," and follows this up with the remark that "the principles of an art are best studied in their application to the highest expressions of that art." These two statements, it will be perceived, are matters of belief; they do not rest on any fact, but are themselves the origin and basis of a succession of statements or theories, all of which lead up to the conclusion—the end of the Creed—that "the only thorough education of an architectural student is one in large problems broadly, simply, and theoretically handled." Which is simply a more cultured way of saying what we had pointed out to be the *Review's* ideal, —that in architecture it is better to study theory than practice if one would be a successful architect. But to get back to the fundamental propositions. The first opens one of the broadest questions in architectural theory. Is architecture an art, and if so, what is an art? We do not mind in the least confessing that, when another uses these expressions, we do not know what they mean. We do not know that we would use them ourselves, or, on the other hand, that we would refrain from using them. Only a short time ago a body of English architects published a thick volume wholly concerned with finding an answer to the question whether architecture was an art or a profession, and we do not know that anybody is the wiser for all their reams of paper and pages of print. And so we cannot, in justice to the *Review* or ourselves, undertake to comment upon its Creed, or even reproduce it in these pages, as we once planned to do, unless it explains its fundamental position. And we have no doubt that others—the English architects are a case in point—are equally at a loss to know what any one may mean by the words "architecture is an art."

WE trust that our position on the educational question has been made entirely clear. It is,—as we have often before taken occasion to point out,—that, since architecture is a practical subject, its principles can be gained only from a study of practical questions and problems. We regard the fanciful, unreal problems presented to the students of our Frenchified architectural schools as being quite out of place in a seriously arranged system of education. We are quite unable to understand why *what is not* should be studied in the schools when *what is* is ignored. It was for this reason we took occasion to remark, in the paragraphs to which the *Architectural Review* refers, that the lack of study of business buildings and other practical problems was one reason why there were so many bad things in current work. We are astonished to learn from the *Review* that these problems are not ignored in the Massachusetts Institute of Technology or by itself. As for the latter, we have nothing to say; any periodical is entirely at liberty to publish anything that suits the whim, fancy, taste, ideas or incli-

nations of its editor. Nor can any statement from this source be questioned as regards the former information. We must protest, however, against the *Review's* assumption that, when we state that unpractical problems do not dominate in the schools, we are speaking without foundation of fact. Some time ago we undertook to collect from the architectural schools a series of the problems given to their students. The effort was not very successful, most of the instructors apparently having destroyed their problems as soon as they had done with them. But we obtained several from different sources, and all contained elements of uncertainty and unreality, with reference to limits of site—as applicable to city structures—or of cost or similar questions which are fundamental elements for the architect in practice. And we think no better evidence of the unreality of such studies is needed than is furnished by the plates printed by the *Architectural Review* itself of theses and other problems worked out by the students in the Institute of Technology. Taking the *Review's* first and second volume, we find the following subjects: "An Academy of Music"; "Design for a Villa"—an utterly impracticable, impossible design on a scale no American would think of building; "Design for a Loggia"—a harmless-enough exercise, but who builds loggias?—"A Memorial Entrance for a Suspension Bridge"—another harmless exercise of doubtful utility; "An Opera-House"; "A Crematory"—on the most stupendous scale, absolutely impossible of execution, because there is no way whereby the funds for such a structure could be had; "A State Capitol"; "A Metropolitan Post-Office"—it ignores the fact that the land on which such a building would be built would be extremely costly and that therefore there would be no room for approaches and wide-spreading buildings;—"An Athletic Club House"—planned with no regard to expense for construction or for land;—"An Official Mansion for the President of the United States"; and "A Railroad Station." Of this list the last is the only one that seems to fulfil the requirements of utility and practicability. But taking the list as a whole, it is impossible to look upon it with satisfaction. The unreal and the unpractical problems predominate overwhelmingly over the real. Boys of twenty are made to design opera-houses and palatial structures no one would dream of confiding to them in real life, and, worse than this, they are taught that architecture consists in such things, and that business buildings, cottages, ordinary residences, and similar buildings are not architecture, or not so much architecture as the fancy things they are trained in. It is no wonder that under such a system current architecture achieves so many extraordinary failures.

THE *Architectural Record* is now engaged in publishing the most extraordiary series of papers on current work we ever remember to have met. It is not often that a writer without a single idea of his own gains entrance to a periodical of any sort, and when we find an eminently sensible journal like the *Record* publishing an extended series of critiques in which the author admits, at the outset, that he is simply borrowing another man's ideas, we rub our eyes with amazement and ask, what next? The articles referred to form an interesting group under the general head of "Wasted Opportunities," the idea being to show architects how, by following certain systems of planning, they might have made a better building, financially, for their clients than they have done. A most excellent notion, and one that might be highly beneficial to the world at large were it carried out in the right spirit. But the writer of the papers has, as we have said, no ideas of his own to employ in his criticisms; he simply takes the general propositions put forth by Mr. George Hill in his paper on the "Modern Office Building," printed some time ago in the *Record*, and to which we have had occasion to refer in these pages, and appropriates them to his own personal uses. Now this is most unjust to all concerned. It is unfair to Mr. Hill to subject his views to the danger of repetition *ad nauseam* which threatens if this series is continued indefinitely;

it is unfair to the readers of the *Record* to palm off another fellow's ideas as your own; it is unfair to the architects criticised to measure their performances by a yard-stick or standard gage, and ruthlessly condemn because they do not come up, not to your standard, but to another's, which you have taken upon yourself to use as your own. A wholesome discussion of the subject would be highly profitable if conducted in the right spirit and with proper appreciation of all the difficulties and circumstances attending the arrangement of a building. But in the present series we have nothing of the sort; Mr. Hill said thus and so, and therefore this and that is bad, a system that probably puts more onto Mr. Hill's shoulders than he may be willing to assume. Incidentally we may remark that it is not necessary to spread over several pages information that is contained in a single brief table, nor should the author of an article, and much less one who owes all he is to another man, give public notice of the fact that he thinks his work is doing good. That may be so, but he is not the one to tell of it. The *Architectural Record* is becoming a great demonstrator. On one page we find the author of "Wasted Opportunities" demonstrating that the planning of our most conspicuous architects is utterly bad. On another Professor W. H. Goodyear is demonstrating that there can be and was no such thing as spontaneity in the origin of ornament. Perhaps it would be better if we could demonstrate, in the mathematical sense of the word, all artistic questions; the *Record* is evidently doing all it can to hasten the day when that will be possible. Verily these be great times for architectural literature.

POOR Mr. Gordon Bennett is having a dolorous time trying to improve the architecture of the American metropolis. His methods are at once characteristic and natural. In his first attempt he went to the most eminent firm of architects in New York, which is to say the busiest, and they speedily supplied him with a design made by an Italian gentleman, who conveniently lived in the sixteenth century, and who, in the natural order of affairs, being dead, could not raise a protesting voice against the wilful and deliberate appropriation of his property. There is no reason to suppose that the results of evil-doing have not followed in the present instance, for admirable as the deceased architect's work was as he did it, there is little satisfaction to be had from its New York reproduction. It was a bold thing to set up an Italian palace front as the outer form of a business building, and many worse things than this have been done without even taking dead men's belongings, but in the present instance the trapozoidal shape of the lot very materially injures a design suited only to a regular plan. But whatever the reason, there is very good evidence to show that the result was eminently distasteful to the energetic newspaper proprietor's mind, for in his next effort to raise the architectural standard of New York, he did not even apply to a firm of architects, eminent or otherwise, but invited the whole earth, architects and builders,—what a commentary on eminent work was that!—to send him in plans and specifications for a sixteen-story steel construction building, for which he agreed to pay the munificent sums of $500 and $250 for best and second best. No incidental expenses in this job, mark you. A more monstrous affront was never offered to the profession, nor could greater contempt have been put upon the gentlemen who had labored so zealously with the work of the deceased Italian gentleman, as aforesaid. And the result was just what might have been expected. Two of the most frightful designs ever produced were obtained as the result of this generous attempt to help architects. It is impossible, within reasonable limits, to give any notion of how these imaginary structures —for it is not conceivable that either of them will be erected—rise and stop, and swell and bulge and start again, and soar and rise, up and up, with pinnacles, towers, dormers, roofs, chimneys, and all manner of strange shapes, fantasies, dreams, idiosyncracies, and aberrations until one is positively amazed that such things could be, and that so much variety could be had for so little money—including speci-

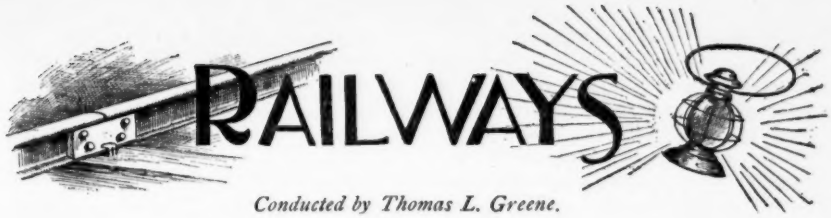
fications and plans, remember. It was quite natural that these creations should have been published in the newspaper conducted by this eminent New Yorker, and quite as natural that they should have been accompanied with an article extolling them and the ideas (?) they represented or attempted to represent. Truly, we may agree with the scribe who describes them, that in architecture "New York is immeasurably ahead of Chicago." For the Chicago eye is, as he sagely adds, "unaccustomed to the great beauties of architectural merit." At this point Mr. Bennett rested from his arduous labors in improving New York architecture, and every one interested in the same good work must be happy because he did so. It is a pity that when so cultured and well-meaning a man undertakes to institute a reformation in so important a subject, he and his advisers should not begin by first learning themselves some few elementary principles of the subject they seek to enlighten befogged people about.

THE National Academy of Design is in a great stew, and all because, like Mr. Bennett, it has undertaken to raise the architectural standard of New York by erecting a new building for itself. It feels, and perhaps rightly,—it is the best judge of this itself,—that it needs a new building, and that its present structure must be made over again or a totally new one erected. Apparently it inclines towards the latter view, of which, as in all questions of this sort, it is the best judge. But instead of proposing a new building that can be erected with its present funds, or with funds readily obtainable, it is fascinated with an elaborate design prepared by a gentleman who has come forward recently as the author of a series of designs of elaborate, expensive, and almost too-costly structures for this hard, money-making, unartistic age of ours. Of the design itself nothing need be said, the published pictures in the daily press being too inadequate to enable one to form any sort of judgment. It is much more to the point to consider the financial elements of the problem; and when a perfectly satisfactory structure could be had for half the cost of the proposed palace, or even for less, it is quite impossible to sympathize with the difficulties which beset the Academy because it has not the wherewithal to build a great building wholly beyond its present financial abilities. This is a notable example of a method not uncommon in ordinary practice of designing a building irrespective of conditions, and then trying to get the conditions to fit the building. A more logical system, certainly, would be to study the conditions first, and then make the building fit them. There is no encouragement in the fact that a body of wise men, like those forming the Academy of Design, should follow an irrational and ill-advised method in their architectural efforts. The hope is expressed, we believe, that some patriotic New Yorker will seek to emulate some of the generous citizens of Chicago in donating the whole $2,000,000 needed for this new building. While the newspaper cuts are especially unfit for serving as a basis for judgment, we should be exceedingly sorry to see any one spend two millions for a structure of so ordinary an elevation as that put forth in this case. Nor do we see any reason for telling the public that it was designed in Paris, because the author was a pupil of a French government architect. Has its author a series of stock designs, composed in his student days, that he brings out before the public whenever an apparently fitting opportunity occurs? We fully believe in the architectural student's busying himself with the practical problems of real life, but, bless our soul, we would not have these youthful essays drawn out of portfolios when an actual or possible job comes along.

AMONG the most important factors in the art development of America the Metropolitan Museum of Art in New York stands easily first. The richest and most important museum in America, containing collections that compare favorably with many of the large collections of Europe, and which in one or two instances are the finest in the world, it naturally attracts students from the whole country, and is thus a national as well as a New York institution.

The trustees have long made it one of their especial cares to utilize the educational value of their collections to the utmost, and the schools of the Metropolitan Museum are wide and favorably known. Of these we need only here refer to the architectural school, which possesses some positive advantages of its own and which really has a distinct position among the architectural schools of the country. With so admirably conducted a school as that at Columbia College close at hand, it would have been an unnecessary duplication of resources to conduct a school on established models. Professor William R. Ware, who, happily for the museum, joins the chairmanship of its committee on schools with the professorship of architecture in the School of Mines, has recently arranged the architectural courses for drawing alone. It is thus possible for the young man who is unable to pass the somewhat rigid entrance examinations of the collegiate architectural schools, to spend one or two years in the museum school, during the whole of which time he has thorough and extensive practice in drawing, while making up, if he wishes, such studies as he may be deficient in. At the expiration of his course in the museum he can enter the School of Mines or any other of the architectural schools, and, if he has worked hard, he can well save a year through his preliminary studies; or he may, if he chooses, go directly to an office, where his long apprenticeship in drawing at once gives him a decided advantage over other young men who may be entering at the same time. And the Museum school does more than this, for the opportunities for architectural study in New York are so abundant that an earnest student at the Museum can readily make up its lack of historical teaching by extra lecture courses, and thus, at very small expense, gain almost the entire advantage of the ample facilities of the metropolis in this department. The present is the second year during which the Museum schools have been conducted on this plan, and there is no question of its success. Young men are given the opportunity to practise drawing on the same system as that pursued at Columbia, and the Museum is enabled to use its rich collection of architectural models and casts in the best possible way at a minimum of cost to itself.

THE *American Architect* is celebrating the close of the World's Columbian Exposition by publishing a review of it composed by a gentleman who somewhat naturally regards the fact of having attended it almost daily as a special qualification of fitness. Perhaps it is, but what shall be said of a writer who, undertaking to describe the Fair critically, introduces in an early stage of his description a remark to the effect that not only does the Administration building "tower above all its surroundings, but like few other buildings that have been erected can be almost said to tower above criticism"? The critic naturally adds that "It is the apotheosis of classic and renaissance architecture by one of the great living masters." We have no wish to say unpleasant things, and the intentions of the *Architect* in publishing this review are most laudable, but certainly these sentences we have quoted exceed in silliness all the other foolish, unwise, absurd and senseless remarks about the Fair that we remember to have met. And our acquaintance with such remarks is not limited. It is writing such as this which makes Americans so ridiculous in the eyes of soberer-minded foreigners, and it is just this spirit which has deprived American critical writings of the Fair and its buildings of all value and profit. But we quite agree with this author when he says that the Administration building must have been at once "conceived as a whole, and is not the labored result of repeated studies, for the executed building does not differ materially from the original sketch." The reasoning is bad, for few architects rush into print with their preliminary studies, and few important changes are found in carefully-studied buildings after the published drawing is made, because it usually represents the finished work of the architect. But we think it quite likely that had further study been given to the Administration building, some very manifest improvements would have been made in it.



Conducted by Thomas L. Greene.

ONE illustration of the pressure of declining rates upon the finances of railways is shown by a fact noticed by few and not heralded from the car-tops by the companies themselves, namely, that two first-class dividend-paying railways, for the fiscal year ending last June, charged to capital a large part of the cost of renewing their equipment. Had this cost been charged to operating expenses, where it belonged, the results of the year as stated in the income accounts would have shown that the dividends paid had not been earned.

Experience has taught us that every company or manufacturer in active business must allow for depreciation. The plant may be yearly depreciating in value, while the machinery must at intervals be renewed or replaced by more modern inventions. Exactly what amount should be allowed for this wear and tear will differ in different lines of business. But when the probable sum is found by trial, it should be spread over the term of years by the deduction of a proportion of the amount each year from the earnings before the surplus is divided among the shareholders. By universal consent the railways reach the same result in another way. They do not charge off a specific sum each year for depreciation, but in theory make the necessary proportion of repairs and renewals annually, putting the cost in the operating expenses, while manufacturing companies state the yearly proportion of that cost as a separate item. As a certain portion of railway equipment wears out each year, the plan works well when faithfully carried out. This policy has its dangers, however, for roadbed and equipment may be neglected until a large sum is found to be needed for economical working. Sometimes, when pressed, a company will repair and renew, but in some way manage to charge the cost to capital to be covered by the issue of bonds or stock. The practical man has a soft place in his heart for the perplexed manager who stands between the stockholder or bondholder and the public, and often can satisfy neither. Yet it is also true that if renewals are not paid for from earnings, the shareholders will one day find a next-to-worthless plant on their hands. One of the simple tests applicable to companies which are suspected of presenting a false prosperity by this erroneous charge of equipment renewals to cost of property, is for those interested to procure copies of the annual reports for several successive years. A brief comparison of the numbers of engines, passenger- and freight-cars in service from year to year will show whether the lists have increased, and to what extent. A glance back at the charges to capital (which ought to be set out in full in each report) will quickly reveal whether the increases in the equipment in service agree with the numbers charged to capital account. If they do not, an explanation is in order.

OF course this method is not applicable to the roadbed and track. The proper plan in such cases, where an inspection of the property is not desired for any reason, is, as before, to obtain copies of the annual reports for as many years as possible. A table can then be made for each year of the average operated mileage (not the mileage at the close of the fiscal year) and of the expenditures put down in the reports under the head of maintenance of way and structures. Dividing one set of figures by the other will give the amount spent annually per mile, which is the only proper method of comparison. These amounts per mile can then be compared with the amounts

charged to this account by other roads situated in the same territory. Care should be taken to select railways which are similar to the one under examination. Averages of groups are of little value unless the conditions of all are substantially alike. Averages for the whole United States are useless. The New York and New England, for example, should not be compared with any road out of New England, nor (as was once done) with the averages of the Massachusetts railroad commission's report for the whole State, which included the rich Boston and Albany and the Old Colony. The road in question is most fairly judged by comparisons with the Fitchburg, the railway most nearly resembling it. If these sums of road expenses per mile vary greatly from year to year in the reports of the same company, it is a matter for further investigation: there may be some good reason for at least a part of such variation. A larger volume of traffic may compel some additional expenses in that year or may justify the spending of larger sums than usual on the property.

Another reason for variation in expenses for maintenance and renewal between companies or between different annual reports of the same company, may be found in the different practice of railways regarding betterments. The English theory is that every item of expenditures which in the least adds to the original cost of the property should be charged to capital and paid for by bonds, while the surplus resulting in each year from the deduction of operating expenses (thus narrowly defined) from gross receipts should be paid in full to shareholders. Even in England this theory has lately received some criticism. Financial writers have begun to call public attention to the enormous and increasing capitalization of English railways, which is now an average of more than $200,000 per mile, while American lines as a whole show only about one-fourth of that sum. The question is asked in Great Britain whether the railways can hope to continue earning returns on this augmenting capital if British trade should seriously suffer in the future. Ultimately this theory will have to be abandoned.

ALTHOUGH the theory has never been firmly held in the United States, still the influence of the large number of foreign holders of our stocks and bonds has had its effect upon American management. As applied to American railway affairs the theory is dangerous. Traffic is comparatively steady in England, but fluctuates greatly in the United States. It must of necessity be that the business of a young and growing country with many undeveloped resources, is speculative in the good sense of that word, and that railways must follow the ups and downs of general business. If a company during a year of prosperity should put none of its extra profits into its plant, it would not find its property in excellent condition and capable of withstanding the strain of a poor year, when adversity came, as come it certainly will. A general rule more applicable to railways in the United States would be to charge to capital only such improvements as increase capacity or permit a direct return in earnings. This rule would not always allow of a charge to capital for the extra cost of replacing a wooden bridge by an iron one, for example, a custom almost universal and defended on the ground of a permanent increase in the value of the property. But a railway, be it remembered, is of no value except for transportation. The whole plant is to be appraised, not as real estate, but only according to its earning capacity. In short, its net earnings, fairly stated, constitute the only real criterion of its value to bondholders or stockholders. Consequently the proper distribution of the cost of small improvements should be governed by the fact whether the net earnings are or are not helped thereby. But iron bridges permit longer and heavier trains, some one will say. Whenever that is true, then as a matter of broad policy it justifies the charge to capital to that extent, but it does not follow that every bridge should be so treated. And indeed, where traffic is increasing but net earnings are not growing in like proportion (and many roads find themselves in that position), there are always increases in imperatively needed facilities which rightly demand the expenditure of money

to be charged to capital to the full extent of the proportion of increase in profits, without further charges for mere changes in plant which involve no gain in net earnings. However, only a general principle is here contended for. The circumstances of each road must be considered in deciding upon a proper policy; for circumstances alter cases.

THE decision of the United State Circuit Court of Appeals on the Texas and Pacific case closes the matter so far as the California rates of that road are concerned, but leaves the general question as open as before. The Texas and Pacific took California shipments from Europe via New Orleans at through rates which give that road but a fourth as much as its proportion on local shipments from New Orleans to San Francisco. The company defended itself against the order of the Interstate Commission by the simple argument that if it did not accept such European rates and proportions, the freight would go to California all water. The court declined to decide the general question whether differences in shipment originating in Europe justified a difference in treatment by American rail-carriers who formed but part of a through route. Declined in set terms, that is, but practically admitted the right of the railway to make a reasonable difference. "That some dissimilar conditions justify dissimilarity in rates is true. That remote dissimilarities of condition justify any dissimilarities which the carrier chooses to make, is not true." It must be acknowledged that the proved differences on the Texas and Pacific were so great as to lead to the conclusion that the import rates were below cost, or the local rates extortionate. The court therefore took a common-sense view of that case.

But the equalization of European rates on imports and exports through all American ports is a hard problem. Some saving in handling flour from Minneapolis to Liverpool, over flour shipped to the Atlantic seaboard and then reshipped, must be conceded. Further, we must acknowledge that since Liverpool fixes the prices on wheat, any saving in transportation is a benefit to the northwestern grower. The seaboard exporter, by the changes in the method of carrying and selling grain, has usually been able to offset the possible advantages of a lower through rate and so to keep his trade. On flour, however, the European shipments are made directly through at a slight saving. If we say, as many do, that the railway rate should be the same whether the flour is consumed in New York city or Liverpool, the traffic man asks what an American road should do, if the Canadian Pacific should take flour from Minneapolis to Liverpool via Montreal at a reduction under the rate via Boston or Philadelphia? It is a hard question. The Texas and Pacific decision would seem to say that at least violent differences between American and foreign shipments are unjustifiable. We are not much nearer a solution than that.

IT is always refreshing to find the courts taking a sensible view of transportation matters. The legislature of Massachusetts passed a law making mileage tickets compulsory and interchangeable upon all roads within the State. The illegality of the act seemed so clear that one company declined to obey, its action being now upheld by the Supreme Court of Massachusetts. The court took objection to several points. The law in effect authorizes one railway to determine the condition and terms upon which another railway shall transport passengers, and that, too, without the latter's knowledge or consent. Then, again, the law would deprive a company of its right to receive its fare in money and in reality compel it to become a creditor of a railway with which it might have no dealing, and which it might not be willing to trust because of actual or probable insolvency. In effect such a law would amount to confiscation, because it would be taking private property for public use without compensation. The government, whether State or national, cannot deal with private corporations unjustly. There was a dissenting opinion in this case which did not amount to more than the saying that mileage tickets were demanded as a public convenience,

charged to this account by other roads situated in the same territory. Care should be taken to select railways which are similar to the one under examination. Averages of groups are of little value unless the conditions of all are substantially alike. Averages for the whole United States are useless. The New York and New England, for example, should not be compared with any road out of New England, nor (as was once done) with the averages of the Massachusetts railroad commission's report for the whole State, which included the rich Boston and Albany and the Old Colony. The road in question is most fairly judged by comparisons with the Fitchburg, the railway most nearly resembling it. If these sums of road expenses per mile vary greatly from year to year in the reports of the same company, it is a matter for further investigation: there may be some good reason for at least a part of such variation. A larger volume of traffic may compel some additional expenses in that year or may justify the spending of larger sums than usual on the property.

Another reason for variation in expenses for maintenance and renewal between companies or between different annual reports of the same company, may be found in the different practice of railways regarding betterments. The English theory is that every item of expenditures which in the least adds to the original cost of the property should be charged to capital and paid for by bonds, while the surplus resulting in each year from the deduction of operating expenses (thus narrowly defined) from gross receipts should be paid in full to shareholders. Even in England this theory has lately received some criticism. Financial writers have begun to call public attention to the enormous and increasing capitalization of English railways, which is now an average of more than $200,000 per mile, while American lines as a whole show only about one-fourth of that sum. The question is asked in Great Britain whether the railways can hope to continue earning returns on this augmenting capital if British trade should seriously suffer in the future. Ultimately this theory will have to be abandoned.

ALTHOUGH the theory has never been firmly held in the United States, still the influence of the large number of foreign holders of our stocks and bonds has had its effect upon American management. As applied to American railway affairs the theory is dangerous. Traffic is comparatively steady in England, but fluctuates greatly in the United States. It must of necessity be that the business of a young and growing country with many undeveloped resources, is speculative in the good sense of that word, and that railways must follow the ups and downs of general business. If a company during a year of prosperity should put none of its extra profits into its plant, it would not find its property in excellent condition and capable of withstanding the strain of a poor year, when adversity came, as come it certainly will. A general rule more applicable to railways in the United States would be to charge to capital only such improvements as increase capacity or permit a direct return in earnings. This rule would not always allow of a charge to capital for the extra cost of replacing a wooden bridge by an iron one, for example, a custom almost universal and defended on the ground of a permanent increase in the value of the property. But a railway, be it remembered, is of no value except for transportation. The whole plant is to be appraised, not as real estate, but only according to its earning capacity. In short, its net earnings, fairly stated, constitute the only real criterion of its value to bondholders or stockholders. Consequently the proper distribution of the cost of small improvements should be governed by the fact whether the net earnings are or are not helped thereby. But iron bridges permit longer and heavier trains, some one will say. Whenever that is true, then as a matter of broad policy it justifies the charge to capital to that extent, but it does not follow that every bridge should be so treated. And indeed, where traffic is increasing but net earnings are not growing in like proportion (and many roads find themselves in that position), there are always increases in imperatively needed facilities which rightly demand the expenditure of money

to be charged to capital to the full extent of the proportion of increase in profits, without further charges for mere changes in plant which involve no gain in net earnings. However, only a general principle is here contended for. The circumstances of each road must be considered in deciding upon a proper policy; for circumstances alter cases.

THE decision of the United State Circuit Court of Appeals on the Texas and Pacific case closes the matter so far as the California rates of that road are concerned, but leaves the general question as open as before. The Texas and Pacific took California shipments from Europe via New Orleans at through rates which give that road but a fourth as much as its proportion on local shipments from New Orleans to San Francisco. The company defended itself against the order of the Interstate Commission by the simple argument that if it did not accept such European rates and proportions, the freight would go to California all water. The court declined to decide the general question whether differences in shipment originating in Europe justified a difference in treatment by American rail-carriers who formed but part of a through route. Declined in set terms, that is, but practically admitted the right of the railway to make a reasonable difference. "That some dissimilar conditions justify dissimilarity in rates is true. That remote dissimilarities of condition justify any dissimilarities which the carrier chooses to make, is not true." It must be acknowledged that the proved differences on the Texas and Pacific were so great as to lead to the conclusion that the import rates were below cost, or the local rates extortionate. The court therefore took a common-sense view of that case.

But the equalization of European rates on imports and exports through all American ports is a hard problem. Some saving in handling flour from Minneapolis to Liverpool, over flour shipped to the Atlantic seaboard and then reshipped, must be conceded. Further, we must acknowledge that since Liverpool fixes the prices on wheat, any saving in transportation is a benefit to the northwestern grower. The seaboard exporter, by the changes in the method of carrying and selling grain, has usually been able to offset the possible advantages of a lower through rate and so to keep his trade. On flour, however, the European shipments are made directly through at a slight saving. If we say, as many do, that the railway rate should be the same whether the flour is consumed in New York city or Liverpool, the traffic man asks what an American road should do, if the Canadian Pacific should take flour from Minneapolis to Liverpool via Montreal at a reduction under the rate via Boston or Philadelphia? It is a hard question. The Texas and Pacific decision would seem to say that at least violent differences between American and foreign shipments are unjustifiable. We are not much nearer a solution than that.

IT is always refreshing to find the courts taking a sensible view of transportation matters. The legislature of Massachusetts passed a law making mileage tickets compulsory and interchangeable upon all roads within the State. The illegality of the act seemed so clear that one company declined to obey, its action being now upheld by the Supreme Court of Massachusetts. The court took objection to several points. The law in effect authorizes one railway to determine the condition and terms upon which another railway shall transport passengers, and that, too, without the latter's knowledge or consent. Then, again, the law would deprive a company of its right to receive its fare in money and in reality compel it to become a creditor of a railway with which it might have no dealing, and which it might not be willing to trust because of actual or probable insolvency. In effect such a law would amount to confiscation, because it would be taking private property for public use without compensation. The government, whether State or national, cannot deal with private corporations unjustly. There was a dissenting opinion in this case which did not amount to more than the saying that mileage tickets were demanded as a public convenience,

Cheaper fares for certain kinds of passengers, or upon certain trains, is often not an unreasonable request, but is one which the railways have not yet succeeded in solving. While the Massachusetts act was clearly illegal and not to be defended on any ground, yet it serves notice upon the companies to address themselves to the problem, to the end that some way to meet it may be found by the railways themselves. In a recent address President Ingalls said that through passengers carried in expensive trains did not pay enough, while way travelers, considering their accommodations, paid too much. In what way can we arrange to charge each passenger his proper fare?

A LEGAL question of some importance seems now in a way of settlement. Several men prominent in Ohio bought on margin the stocks of three small coal roads and formed the present Columbus, Hocking Valley and Toledo. They put upon the consolidated road a blanket mortgage of $8,000,000 for the declared purpose of double-tracking the road and otherwise improving the property. It is claimed that under the pretence of buying coal-lands from themselves they practically reimbursed themselves for the stocks first purchased by turning these new bonds over in payment for the land. The company tried several times to throw off the mortgage, but was each time defeated, because the officers of the road acted within their authority in creating the mortgage, holding the stock of the company at the time. Recently, however, a suit brought by an outside party interested in the road asked for a settlement with these old officers, which suit the New York Supreme Court has upheld in spite of the good technical defense. Every day makes fraud in railway finance more difficult and more disreputable; so far as fraud was present in this old matter it is for the interest of all that it should now be brought to account.

THE receipt of the English returns to parliament on the accidents on British railways for the first six months of 1893 is a reminder that thorough investigations into all accidents and public reports thereon are peculiarly within the province of our State railroad commissions. Minute investigations into each accident in England are undertaken under the orders of the Board of Trade (a semi-public body) by the officers of the royal engineers. Their findings, with the testimony, are made public, though the board has no further power of coercion. Nevertheless the censure (if censure there be) of an impartial member of the engineer corps of the British army has great weight. No English railway likes to have it reported in print (for instance) that it kept a signalman on duty for, say, fourteen consecutive hours, and that his mistake which wrecked a train was the result of too long service; or that the company was blameworthy in its care of the track or in any other particular. English railway discipline is high, and very few accidents, compared to the number of trains, are reported. It would be a great advantage in the United States if we could have had expert examinations made into the real underlying reasons for the shocking accidents of the last two months. If the management was negligent, the fact should be known. If the pressure for cheapness was the real cause of the accident, the public should know it, and also whether the rate or fare problem probably led to the unwelcome economy.

A MAJORITY of railway-men look for a dull winter. The World's Fair has contributed to swell the passenger earnings for the summer and fall and thus for a time to counteract the decline in the freight traffic. For a while the traffic may be light by contrast. These same men are also of the opinion that traffic is in sight, though it may not immediately move. In short, all the evidence favors a return to good business and fair prosperity. But when? The heavy losses in earnings on the Union and Northern Pacific railroads afford one more example of the dependence of the railways upon the business prosperity of the sections served; as traffic has declined on these roads, so will it increase again when confidence sets all wheels in motion.

Conducted by Albert Williams, Jr.

THE revival of gold-mining in the far West and on the Pacific coast has been remarkable. It is true that in large part this has been forced by the decline in silver-mining, which has caused capital and men formerly engaged in that branch to turn to gold-mining. There is a certain kind of capital which seems inevitably to seek investment in precious-metal mines, and when discouraged in one direction it flows naturally to the other; while the large number of miners thrown out of employment by the closing of silver-mines or reduction in force had to find employment, and they turned to prospecting for gold, or taking up abandoned gold claims or "leasing" on others. The result has been a considerable development in several quarters, notably in the Cripple Creek gold-district in Colorado, where a veritable "boom" has set in. So far the total production from that camp has not been very large, but there are about eighty mines and prospects that have each yielded something, spread over a tract about twenty miles square. It is not unreasonable to believe that with so extensive a showing the future output, when the mines are better opened, will be very heavy. The camp is only two years old now.

It was expected that by this time arrangements would be made to reopen many of the great hydraulic placer mines of California under the new "débris" law; but as the Senate failed to confirm the appointments of the commission having the matter in charge, there is a question as to their authority to issue permits, and the anticipated revival in this branch of gold-mining is for the time delayed.

SILVER-MINING is in a very depressed state, but hardly any worse off than for many months past. Foresighted operators long ago had made up their minds that Congress would annul the silver purchase law, the almost sole prop of the market, and had discounted the outcome, just as had the bullion-dealers. So when the final decision of Congress was announced, it affected prices very little and mining not at all, for it was already at about the lowest possible ebb. Indeed, there has since been a sort of feeling of relief that the worst was over, and, if anything, there is a little more life. At this season of the year, without regard to other causes, it has been customary to close down many of the mines at high altitudes on account of snows. This year, it is true, not very many operating mines were left to suspend. But it is a fact that after Congress had adjourned a few silver-mines actually reopened. Those which produce a considerable proportion of gold in addition to their silver are of course in the best position to stand hard times. The exclusively silver-mines, with very few exceptions, will find it extremely difficult to make both ends meet under existing conditions. A curious feature of the situation is the sudden and artificial rise in the quotations for Comstock shares, which suddenly and without apparent reason jumped 300 per cent. and more after the silver purchase law had been wiped out. Ill-natured and suspicious people hint that this was in view of the approaching Midwinter Exposition at San Francisco, and the belief that a lot of Eastern and foreign visitors could be coaxed into the same old game and absorb stock unloaded upon them at good figures.

WITH the coming on of winter each year the question of short-weight coal is brought to the surface anew. In New York city there has always been complaint

on this score, and while it may not justly apply in the case of the larger dealers, it certainly does in the case of those who supply the poor in small quantities from peddling wagons and by the bucket. For two years the New York Coal Exchange has been making strenuous efforts to abate the nuisance on the one hand and to verify the honesty of dealers on the other. Two plans have been proposed: (1) that the Exchange should employ its own inspector to weigh the coal on loading at the yards, this on agreement with each individual dealer,—and it is perhaps a little significant that a very considerable number of dealers declined this proposition; (2) the other plan is that the Exchange's inspector, on request of the purchaser, should weigh the coal on delivery, at a nominal charge, say 5 cents a ton, the inspector to be provided with portable beam scales, etc., and also test other scales. The Chicago Retail Coal Exchange has a similar system of inspection. Of course there are in many large cities official public weighers, but the amount of good they do is problematical. When, however, a coal exchange goes seriously to work to protect not only the customers but also the good name of its honest members, that is something like business. This short-weight question directly concerns the coal-producers. There is a perpetual wrangle over prices, and consumers are always grumbling, and especially in the case of anthracite there is the annual complaint that prices are too high. There is really very little profit in coal-mining at present; in fact, some of the large concerns operated in connection with railways are often run at a loss. Between miner and consumer it is easy to account for the advance, which is distributed among railway haulage or canal freights or both, one or two middlemen's profits, and in some cases the cut from the long ton of 2240 pounds to the short ton of 2000 pounds (which too often is found to be 1800 pounds or so).

THE coal-mines of Missouri, like most of those throughout the West, have the advantage of being shallow, and thus saving in average hoisting and pumping expenses. Most of them are less than 200 feet in depth. One of the deepest is in the Randolph shaft, in Ray county, 420 feet to the coal. The deepest mine is near Hamilton, in Caldwell county, about 500 feet. There are seams at greater depth, not yet operated.

AT last what appears to be a practicable method of coaling war vessels at sea has been introduced, and was lately experimented with by two United States ships off Sandy Hook, both moving at about four knots and a hundred yards apart. The speed could have been increased, but it is doubtful whether the system in its present stage would be successful in a heavy seaway. A trolley line connected the two vessels, and over it the coal was transferred in sacks—not very rapidly, it is true, but there was no reason why a second line might not be used. This is a much more important matter than may at first glance be apparent; for the new device promises to solve the problem of coaling stations for our navy; it will enable it to be supplied with American coal, carried to any prearranged point by colliers from home.

THE close economies demanded in present iron blast-furnace practice have brought about some singular results. For example, it has been stated that in some of the Scotch furnaces, which have had to be operated on very small margins,—and of which, by the way, many have recently blown out,—the pig-iron produced has been really the waste product, while the tar and tar products saved have been the mainstay. About half of the Scotch furnaces have been "capped," and the heated waste gases conveyed through miles of condensers and the products saved. It is a rather astonishing fact that in some cases the subsidiary plant to reclaim the waste products has cost more than the blast furnace itself. More familiar examples of blast-furnace economies are the utilization of waste heat for boilers and to heat the blast, and the almost innumerable plans for utilizing the slag, some of which are in successful application; but a mere enumeration of the many directions in which

great or small savings are sought would require a long article, while to discuss them fully would involve the making of a book much larger than the standard complete treatises on iron making of a few years ago. In some respects this complexity of side issues that have to be considered is somewhat discouraging to the metallurgist and the projector of new works, for instead of the simple problem of taking so much material and turning out pig-iron of a certain quality and quantity, at the lowest direct cost, the industry assumes the aspect of a most complicated commercial business, in which there is no end to the details. And every other branch of metallurgy is being forced by competition into the same lines as the iron industry.

AN important placer-mining undertaking is reported to be on foot in northern California. It is proposed to mine the bed of the upper Sacramento river in Shasta county for a considerable distance below a dam built across the stream at Redding. The *Shasta County Democrat* says that the plan is to use a shear-dam a local electrical company has been putting in, which is large enough to carry nearly all the water in the river at this season of the year. By accomplishing this—and competent engineers say it can be done at a reasonable cost—they will be able to work the rich gravel below the dam. The *Democrat* says that there is no question about the gravel being rich in gold, for miners who have worked in the gravel for several seasons past in water up to their waists have been and are now making big wages.

In Colorado and elsewhere a number of river-bed workings have been opened during the last season or are in prospect for the next. Old miners in almost every placer mining region have in mind some pet scheme for getting at river beds by diverting the water or by running bed-rock sluices to dispose of accumulations of old tailings, and doubtless there are many places where operations could be successfully carried through now that would have been hopeless in "early days," when it was so much harder to get capital for undertakings requiring so much time and outlay before realization of profits.

MINING-SHARE speculation is by no means dead, but it is badly indisposed, notwithstanding the recent flurry in the San Francisco shares. Sometimes it is on a scale that is rather pitiful, even if absurd. For example, here is the report in a Denver newspaper of the transactions for the day (taken at random) in the mining exchange of that city. This exchange, it should be remarked, put up a $300,000 building, which it does not now own, and thinks a good deal of itself. So evidently does the newspaper about to be quoted. There is not room here to do justice to its eloquent display head, but it reads as follows: "A Strong Market! A Good Many Stocks in Demand that Can't be Had.—[Susie S.] Stock Goes Up To-Day.—[Araminta] Also a Favorite with the Brokers.—[Snodgrass] Wants [Poverty Flat] in Big Bunches.—The Features of the Market both Locally and at Colorado Springs.—Total on 'Change To-day was 14,000 Shares." Fourteen thousand shares! That certainly has a large sound; but as they mostly went at from half a cent to four cents a share the total foots up just $308.25 for all of them except one block of 500 of a $2.15 stock, which brings it all up to $1383.25 for the day's work of the exchange. It would be painful to figure on the commissions.

TWO decisions in relation to the liability of mine-owners in case of accident to employés have recently been rendered. In one case the United States circuit court of appeals, eighth circuit, has ruled that coal-mine foremen and laborers are fellow servants; that is, that the "foreman" in an eastern coal mine is not a responsible officer of the company in the same sense that the "foreman" of a western gold or silver mine would be. This is in accordance with the common understanding of the word, which has a different significance in different localities; but it is a nice point in definition. The ruling is:

A foreman in a coal-mine, whose duty it is to direct ten or twelve men what work to do, and

to prop the roofs of rooms with timber ; to inspect them and see if they are safe ; to drill holes in the face of the rooms, charge them with powder and fire them ; but who is subject to the orders of the pit boss and the superintendent, is the fellow servant of a laborer under his direction who is injured in performance of his duty, in shoveling and removing coal and dirt, and assisting the foreman in his work.

In a case appealed to the supreme court of Utah, an action against a mining company for injury to an employé, the point at issue was the duty of the company through its officers to warn its men of possible danger unknown to the latter. The court held that :

In an action against a mining company for personal injuries received by an employé, by rock falling down a manway in which he was working, where he claimed that the fall of rock was caused by blasting in a tunnel which was being extended toward the manway, evidence as to the length of time which was required to complete the tunnel, after the accident, was admissible as bearing on the proximity of the blasting to where the injured person was at work. It appeared that the fall of rock could have been prevented by proper precautions on the part of the company ; that the man was ordered to work in this manway, though it was not a part of his duty to do so ; and that the foreman knew the place was unsafe for one unaccustomed to work there. There was evidence that the fall of rock was caused by the blasting in a neighboring tunnel, of which no warning was given, and the employé was unaware of the proximity of this tunnel. A verdict for the employé was justified.

SOME months ago the press dispatches from a Mexican mining district announced that the mine foreman, charged with having been responsible for a fatal mine accident, had been held for murder. How the trial resulted we have not been informed, but evidently they have a summary way in Mexico of treating this question of responsibility.

AN unusual, though not unprecedented, accident occurred September 28 at the Mansfield iron mine, near Crystal Falls, Michigan. The working levels were run directly under the Michigamme river and parallel with it for several hundred feet. The upper level was thirty-five feet below the bottom of the river. Five lower levels, parallel to the first, made a total depth of 425 feet. The upper levels had been stoped out, leaving timbers and ore pillars to carry the superincumbent weight. The accident is thought to have been caused by a giving way of the timbers on the fifth level, allowing those above to follow. Finally the topmost ore and rock caved, and the river poured in, filling the mine, drowning most of those not crushed by falling rock. Of 48 men then on shift underground, 20 escaped and 28 perished. The mine is hopelessly wrecked, and the 250,000 tons of ore supposed to have been in sight are lost. This is one of the many cases as to which it is hard to determine whether the accident was or was not preventable. In the strictest sense, it could have been averted by leaving more "back," larger pillars, and heavier timbering. Yet the mine had been carefully surveyed and had been under constant inspection. The management, fully realizing the danger, cannot be accused of having had so little sense of self-interest as to deliberately invite disaster. Yet the accident did occur.

ALUMINUM seems to be on the eve of making one step more in the direction of lower prices, and consequently of increased use. The latest advance—for in this case a decline in price can be properly termed such—is not a very large one to be sure, but it is in direct line with the continuous series of improvements that have marked its history, and brings just so much nearer the twenty-cent mark which appears to be the limit attainable under systems of metallurgy at all like those now applied in its production. It is now announced that a prominent producing plant in Switzerland is about to place its product (aluminum, not aluminum in alloy) on the market at forty-five cents a pound, which figure the American works can probably meet under present conditions and with their present facilities. It has been pointed out that this figure, taking the low specific gravity of the metal into consideration, places it in matter of bulk as actually

less than tin. These reductions cannot be expected to go on by jumps as during the period when the price came down from $7 to $1 per pound, for the margin for reduction is gradually narrowing. Until some now unknown method of reduction is introduced, the successive drops will be small. In order to bring the matter into square competition with iron and steel, it will have to be made by analogous methods, and a simple direct smelting with ordinary fuel on the large scale is not yet in sight. This, formerly considered a wild and visionary dream of enthusiasts ignorant of chemical possibilities, may yet turn out to be feasible, though the way to it is not yet discovered. At least it is not safe to assert that such a thing is impossible. Meanwhile aluminum, if somewhat disappointing as the "metal of the future," is steadily gaining ground, and metallurgists have reason to be proud of the progress already made in the face of difficulties not so long ago thought to be insuperable.

THE following account of the method adopted for extracting the ore from the iron mines of the Low Moor Iron Company, in Virginia, is given by the *American Manufacturer*.—"About two miles from Low Moor furnace, the company operates, on the caving system, large iron mines in a fine seam of ore running down through the mountain. The miners commence on the top of the seam and take a cave of 12 feet, cribbing up the top as they go. When they have finished that cave they come back to the place of beginning and lay a floor on the bottom of the former caves and then start under this floor and take out 12 feet more. This is repeated until the bottom of the seam is reached. A number of different ways have been tried for mining this pitching ore seam, but this method has proved the most economical and successful. This seam of ore cropped out at several places, but it was thought best to locate at the lowest point. A shaft was sunk 150 feet, out of which the ore is hoisted. This also affords fine drainage, and the mine is kept comparatively dry. There are two fine shafts and two drift openings."

IT is reported that cinnabar has been discovered at Lynn, Mass. This adds one more to the already numerous localities at which this ore of quicksilver has been observed in the United States, and yet of all of them only the California deposits are now productive, though an occasional flask has been produced in Oregon. As to the newly reported discovery, it may be said that the New England States furnish specimens of almost all known minerals, one reason being in the natural character of the country, another in the care with which it has been observed by so many competent mineralogists. With the present restricted demand and low prices for quicksilver it would require a very large and rich cinnabar deposit to make a mine.

A SMALL portable apparatus for making accurate concentration tests has been invented and successfully used. The idea is to avoid the expense of shipping large lots of ore to a concentrating mill for a test run, or to a testing laboratory to determine whether the ore will concentrate and what system or machine would best serve. Such an apparatus can be taken wherever a light buggy or buckboard can go, and should nearly answer the same purpose for preliminary testing as a full-sized concentrator, which is a bulky machine, seldom weighing less than a ton, and with most styles requiring some skill in setting up and adjusting.

ACCORDING to a ruling of the Interior Department publication of notices regarding mining locations, mining land patents, etc., must be made in a newspaper of general circulation and the nearest to the place where the property in question is situated.

THE statement is made that every gem stone known to jewelers has now been found somewhere in the United States. Yet Mr. George F. Kunz's estimate of the value of the precious stones of American production marketed in 1892 is only $188,000. Without doubt there is here a promising field that has hardly begun to be occupied.

MACHINE SHOP PRACTICE

Conducted by Albert D. Pentz.

WHILE the speed for cutting iron and steel should be low, the feed may be much greater than most workmen believe. If a planer has the power and rigidity, and if the part in operation be solidly upheld, more metal can be removed with a fast feed and slow speed than if the conditions were reversed. Cutting cast-iron at fourteen feet per minute and feeding one-tenth of an inch per stroke is perfectly practicable, and it is more economical than a speed of twenty-five feet, cutting five-hundredths of an inch. These remarks apply to turning, gear-cutting, and milling, as well as to planing.

IT is well known that the bronze made of nine parts of copper and one of aluminum is of the color of gold and will not tarnish. It is of a tensile strength equal to steel. At this time this metal can be produced in castings for about the same price that crucible steel costs, and the castings can be made very true to pattern. Why do we not use it and save the expense of working forgings to shape? And why do we not use it for the improved artistic effect its color will give?

IN calculating how to reduce the cost of an article of manufacture without curtailing its efficiency or appearance, it is quite as necessary frequently to modify the parts of the article itself as it is to design improved tools and fixtures. Often two or more pieces may be consolidated into one. Shapes may sometimes be made different to facilitate the machining, and patterns usually can be changed to simplify molding. A manufacturing engineer constantly has these things to take into consideration, and when all of them are properly taken care of, results begin to show at once.

THE greatest factor in profit-getting in modern manufacture is that all the regular work shall be done by the piece and not by the day. Men who work by the piece have an interest in new tools of rapid execution, and they study new methods to facilitate the completion of their operations. Hence it is suggested that such concerns as still manufacture standard articles by day's work should try piecework. Without doubt it will be more satisfactory than it is to put boys and girls on men's work. With piece-work, too, a man must do good work to get paid for it, for if he does not make satisfactory products he loses his labor and in addition must pay for the material he spoils.

PLANERS driven by friction-clutches have not yet been perfected. The writer believes that this is the correct principle, but that the proper application of the clutch has not been made. Doubtless if the speed of the friction surfaces were proportioned to the platen speed at not less than 60 to 1, and if the friction should be upon elastic surfaces properly arranged, the result would be successful.

DE GREE tried to keep his work in his head and of course he forgot some of it. Then he took notes of everything to such an elaborate extent that he could not make sense of it all when the notes were needed. Blunt, who watches him closely, noticed this and delivered this little lecture:

"Your trouble is that you don't act quick enough. Oh, you work hard enough; I am satisfied of that, but you take either a mental note or a memorandum of a thing you should act upon. The way you take notes merely procrastinates the thing you want to do. You found a casting that was

unsatisfactory and made a note of it, instead of sending at once for the pattern-maker and ordering him to correct it. That then would have been done as far as you could do it, and your note should have been one to remind you later to see that the pattern was changed as you had ordered. You will still find this much the more satisfactory method,—it will save your legs and your head as well."

MOST of the small steel castings are merely malleable iron treated with animal charcoal. The operation is about the same as case-hardening, as far as the heating is concerned, but it is continued longer and not quenched in water in most cases. If the charges for such steel castings are much higher than for malleable iron, it may pay to experiment on them in this way.

UNCAST steel, blistered steel, and shear steel are names for raw steel before it is cast into ingots for the purpose of making it homogeneous. This product has fallen into disuse unjustly of late years and should be rehabilitated as a material for many parts of modern machinery when a hard surface over a tough interior is desired.

THERE is no subject more valuable for the study of machinists than the flow of malleable and ductile metals. A malleable metal flows somewhat differently from a ductile metal, and this difference must be understood in making tools to operate such metals. An extremely malleable metal, such as gold or iron, may be lengthened or widened indefinitely by hammering or rolling its surface. This hammering pushes or kneads the mass at each blow, so that while it will contract in thickness between the hammer and the anvil, the amount of the metal thus displaced will flow away from the point of the flow in the direction offering the least resistance. It is obvious that a piece of metal thus hammered will become thinner, wider, and longer. Now, suppose we take a cubic inch of soft iron—such as is called open-hearth steel—and place it cold upon an anvil, cover it with a swage, and strike it with a sledge of certain weight until it becomes "set" and refuses to flow any more with the application of that amount of force. The top and bottom faces will then be found flat and larger than before. The other four faces will be found to be convex, and the four upright corners will be rounded. This indicates that the metal flows toward the sides rather than toward the corners, and that the friction under the flat swage and on the anvil has prevented these two surfaces from flowing as much as the interior of the mass. The heavy weight of the sledge also modifies the flow, the metal in the cube being driven all the way through. A light hammer applied directly to the surface would, on the contrary, expand that surface alone so that the top edge would hang over the sides, as seen on the heads of cold-chisels after considerable use.

In the making of dies and similar tools by hammering or pressing cold metal into shape, the laws of flow need to be learned. The general ideas may be gained by reading, but the practice must come by experience. A slow-moving press will yield results where a quicker one will fail entirely, for cold metal flows very slowly. A heavy drop-hammer ram, falling a few inches and delivering a blow of three tons, will do more and better work than a lighter one falling ten feet and delivering an equal blow. This may be due to the speed of impact which develops heat from a large part of a blow rapidly made. Hence, in embossing, straightening malleable castings, and all manner of press work where the operation is that of hammering or compressing material to shape, the operation should be as slow as is practicable, and with the greatest possible force on each blow. Peening is an indication that cast-iron will flow to a limited extent. This operation should be varied, however, by using the flat face of the hammer alternately with the peen.

DUCTILITY depends upon the tenacity of a metal. Thus if the end of a piece of soft iron wire be reduced 1 per cent., and this small end be entered through a draw-

ing-die which it fits, all the remainder of the wire can be drawn through, reducing its size to that of the die and elongating it proportionately. In this case the small end must pull so hard as to work all the particles composing the wire into new relations with each other. First, the smaller section is drawn forward. This presses the excess of the larger size backward and inward, causing a flow. Cartridge-drawing and other similar operations depend upon ductility. Here, again, speed must be used with caution.

THE operation of burnishing makes a soft metal flow on the spot where the burnisher is applied. This fills up the loose grain to an even surface, makes it smooth, and gives it what polishers call a "color." A rag-wheel burnishes also, and gives color, causing the surface to flow about the same as a burnisher does, but with greater force, for such a wheel can cause a flow on the surface of hard steel, nickel, and other hard metals.

MACHINISTS will find copper to be the most handy metal in one particular,—it can be beaten cold into all manner of forms. Coppersmithing in an ordinary sense requires little or no practice by any one familiar with the use of the hammer and with the flow of the metal. In making small machine models for exhibition, in experimenting on difficult shapes where the experiment has not advanced to a stage which permits dies to be profitably made, and in the making of light hollow patterns, this metal thus formed will be found very valuable.

CAST-IRON boxes reamed very smoothly in oil, will not "cut" or "gall" nearly as much as one reamed dry. Hence, because this metal is one of the most convenient and cheap, and because it is very durable after it has become glazed and hard on the bearing surface, anything that hastens this condition of a glazed surface is a gain to the arts.

IT seems that there ought to be some means to make dense the surfaces of holes in cast-iron after they are reamed. We would suggest a roller stock small enough to enter the hole freely and long enough to extend through it. About this stock there should be a number of small rollers—at least three—arranged in a groove cut into the stock. A point on the periphery of each of these rollers should crowd into the hole to be smoothed tightly, and be held out against the surface of that hole by the bottom of the groove in the stock. Now, by turning the stock the motion is communicated to the rollers, so that they will slowly roll around the inside of the hole and press its surface smooth and hard. Probably if a rolling reamer such as this were larger by a thousandth part of an inch than the hole it was operated in, it could be forced through and would improve the surface of the hole more than enough to pay for it.

THE best expansion reamer is made thus: Take a shell reamer that is worn below size, anneal it and bore it out, tapered about one-fourth of an inch to the foot, so as to leave the shell not less than one-eighth of an inch thick at any point, and thicker in large sizes. Cut this shell at one point lengthwise nearly through from the outside, but leaving a thin wall. Then harden and grind it inside. Next, fit a suitable shank to its taper-hole, with a nut at each end of the reamer, and force the reamer up the taper shank with one of its nuts until it has broken through the thin wall at the bottom of the slot, and further expand it to a size suitable to be ground and sharpened on the flutes as required. It will be found that this reamer may be expanded evenly so that all the teeth will cut the same, that it may be varied in size considerably, and that the friction on the taper of shank and against the nut will be sufficient to drive it while cutting. Taken altogether, it is a most satisfactory tool.

WHEN "Hamlet" alludes to mechanics' tools in the remark that he knows a "hawk from a handsaw," commentators presume that he means the bird of that name, and they go to great lengths to show that

"handsaw" is a misprint. But a hawk is a tool used by plasterers. It is held in the left-hand and takes its name from its resemblance in position to the falcon employed in the ancient sport of hawking. There is no resemblance between a hawk and a handsaw, and the prince of Denmark would indeed have been mad if he had confounded the one with the other.

A HOBBY is a most dangerous thing for a mechanic to ride. Some men, when they find one kind of tool working well, will use it on all things to which it possibly can be applied. Thus, at present, milling-cutters formed on the ends of cylinders are quite the fashion. That such cutters are the best in many cases we freely admit, but that they are the best in all the places where they are used, we certainly deny. It may be that this method is good for cutting machinery, steel and crucible steel, where smooth surfaces to be finished afterward are required, but such results as have come within our observation have been greatly inferior to the peripheral milling. In fact, while the sweeping cut can remove stock most cheaply, it leaves a surface decidedly more rough than that cut by the convex cutter. This may not be so apparent to the touch as it is afterward in the filing or grinding of the surface to a finish. Hence judgment should be exercised in the selection of cutters, and if the surface is to be finished to a polish, preference should be given to the cylindrical cutter. It is true, however, that the sweeping cutter leaves an excellent surface as a foundation to bolt a superstructure upon, being a very true general plane; in fact, we have something as true as good planing at a fraction of the cost. In such places as this the ridgy character of the milled plane in minute detail assists in holding the superstructure on place on the foundation.

EVERY machinist who reads to inform himself on technical matters is of course an ambitious man who seeks to improve his condition in other ways as well as to cultivate his understanding. For such men there are many opportunities for advancement if they are able to accomplish original and profitable results. Work, not talk, is the means by which all things are accomplished, and ability is but another name for intelligent work. What machinist does not know of a defect in some machine or tool, or does not find that one or another device within his knowledge is not what he believes it could be made? Now when a defect is found or an improvement is believed to be practicable, there is no obstacle in the way of the elimination of that defect or the realization of that improvement that may not be overcome by work. First comes the desire for an improvement, then the effort to satisfy it. In nearly every case there are many ways and means for accomplishing a desired mechanical operation or materializing an advanced idea.

IN machinery—as in all things else—there are no new abstract ideas. Hence, when a thing is to be done, it must be done by using a lever or wheel of some kind, a wedge or screw, a belt or chain, a spring or weight, or some modification or combination of these. So in studying to find a new device, what is to be done is to conceive of all manner of probably efficient levers, wheels, wedges, screws, belts, chains, rods, slides, springs, and weights, and to apply each in turn in the manner most likely to produce the result aimed at. When a device is found that seems to have the elements of success in it, no time should be lost before it is roughly made and tried. This of course is but the beginning of improvement, but when a man has gone so far he will pursue the thing to the end. He will find one element weak and select another. He will do a part of the experiment in drawings and a part in models, and at last he will construct the device perfected, so far as he can see perfection at that time. This is the road upward in our art, and an interesting one it is, though it may be laborious.

THE man who is winning a commercial success may well smile at the schemer. The sole defence he needs is contained in the single word—*results*.

TO THE EDITOR:

In your Department of "Machine Shop Practice," for November (page 256), I notice a paragraph relating to a rope-drive which seems to the writer to be working under great disadvantages. In the absence of further information as to exact local conditions, I should think the rope was doing remarkably well "under the circumstances." If the drive is wound continuously, and operated with a traveling slack take-up, as with the Dodge American system, and each floor driven direct from the main driving-sheave, there are too many wheels to insure good results. The life of a rope in such service depends upon the minimum internal friction caused in bending, as well as a liberal proportion between rope and sheave diameters. A rope $1\frac{1}{8}$ inches in diameter is much too large for use on a 36-inch sheave, and I cannot understand what complication would necessitate thirty sheaves to reach six floors, one above the other. Better results would be obtained by connecting each floor direct from the main driver, and winding continuously, passing one rope around a slack take-up operating constantly, and so constructed as to permit shrinkage of the ropes without undue strain,—the shrinkage being quite marked where a portion of the ropes run exposed to the weather. The shape of the groove has much to do with the traction qualities and may effect the strain under which the rope is working. Should the drive be wound as in the English system (*i. e.*, each wrap individual and operating independently), the results are good and bad:—good for the English system and bad for rope-driving in general. A loose-spun three strand rope is the best, but my experience has been that linseed-oil has a tendency to rot the fiber. A better dressing is made of tallow, beeswax, and other ingredients which lubricate as well as form a skin over the exterior of the rope. If the person running the rope-drive mentioned cares to investigate the subject further, I feel confident he will be able to improve the present system and eliminate some of the annoying features now existing which may eventually lead to a serious break-down, and shake his faith in a mode of transmitting power which, if properly installed, is a most satisfactory means of power distribution.

M. W. MIX.

Chicago, Ill., November 7, 1891.

THE rope-drive commented on last month was built by a concern whose works are not in the vicinity of New York. The distribution of the sheaves is about as follows: There are nine and an idler on the jack-shaft near the engine. The drive enters the tower at the third floor. This necessitates deflecting sheaves to change the direction of the rope from the horizontal to the vertical, and *vice versa*. Four loops of the rope in the tower go downward and five upwards, and of course each loop drives a sheave. Then there is the tightener-sheave. A closer inspection discovers a larger number of sheaves than was stated originally. Each sheave is polished in the groove and the grooves in all receive the rope in an angle of about sixty degrees. The traction is satisfactory and the loss of power is small. The tallow and beeswax compound did not work well for these reasons: It caused the rope to adhere to the sheaves and wasted a large percentage of the power. It caused the fibers of manila to break so much that the inside of the tower was coated with a dirty gummy coating of the dressing which was filled with short broken manila and its dust. When the rope broke it was all destroyed inside by having its fiber chewed up by friction or flexion. The present dressing of boiled linseed-oil seems to keep the fibers apart and lubricated. They are not rotted, neither do they show any indications of it, being bright and lively. Recently, there being occasion to cut out a piece to reduce the length, the inside was found to be perfect to all appearances. The outside seems to be worn a trifle and made cylindrical by compression. Inside, the oil is quite fluid, while the skin outside the rope polishes very bright soon after the oil-drip is stopped. The only point the writer has cared to make about rope-drives is relative to the value of boiled linseed-oil for a dressing. Facts have been given, and not opinions. We believe that this oil has not been properly tried before, and that when it is so tried it will be found superior to wax, tallow, or other viscid greases. At present the rope on this drive is doing its work very satisfactorily, and if the next six months' performance equals the last, as it promises to do, the experiment will be an economical success as compared with the belting system of driving. The result will be watched with interest.

COMMENT & CRITICISM

The Early Casting of Iron.

THE article on "The Evolution of the Iron-Founder's Art," in the May number of THE ENGINEERING MAGAZINE, in which the credit of originating the art of casting iron was given to one John Thomas, a Welsh boy, about 1709, contains a historical error.

Swank's "History of Iron in All Ages" contains a detailed account of the first iron furnace erected at or near Lynn, in Massachusetts, and of the first casting made there, prior to 1650, which was more than fifty years earlier than the operations of Thomas and Darby. The mold was made by Joseph Jenkes, and the record shows that he cast "a small iron pot holding about one quart," which was *the first iron casting made in the United States or these colonies.* Swank also states that this pot was preserved, and as late as 1844 was still in the possession of the descendants of Thomas Hudson, who owned the land on the Saugus river on which the furnace was built.

It may be true that castings of iron did not come into general use until after 1700, but there must have been some in this country before that, for the colonists, being in great need of iron kettles and other utensils, would hardly have done without them after this demonstration of the possibility of making them here. It is certain we had cast-iron cannon long before the Revolution, and it is to be presumed many other articles also, although the laws of England for the suppression of all manufacturing industries in the colonies may have suppressed that as they did others. The first cast-iron plow in this country was patented to Charles Newbold, of New Jersey, on June 26, 1797.

Jenkes, who came from England, was evidently a very ingenious man, for I find that the General Court of Massachusetts granted him a patent on May 6, 1646, for "the manufacture of engines of mills to go by water,"—probably some form of water-wheel, there being no description of the engine or device. In 1655 the General Court of Massachusetts granted to Jenkes another patent for a scythe, which is said to be the origin of the long scythe such as has since been used so much by farmers. It has been repeatedly stated in print that this was the first patent granted in this country, but that is obviously an error. Not only was his first patent granted five years before, but even before that—June 2, 1641—a patent was granted by the General Court to Samuel Winslow, for ten years, for a method of making salt. This was the first patent granted in this country. The first patent granted under the patent law enacted by Congress April 10, 1790, was one to Samuel Hopkins of Vermont, bearing date July 31, 1790, for the manufacture of pot and pearl ash.

On May 6, 1646, Richard Leader, the general agent of the company, purchased "some of the country's gunnes to melt over at the foundery," which clearly indicates that they had cast-iron guns at that date, though they may have been cast in Europe and brought to the colony. Besides, the privileges granted to the company by the General Court in 1644, and increased in 1645, gave to the company the free use of all materials "for making or molding any manner of gunnes, pots, and all other cast-iron ware," which indicates that it was a known art at that time.

I have been led to make these corrections from the *official records*, because the erroneous statements have been so extensively copied by papers and writers all over the country, and to the end that "the truth of history may be preserved."

W. C. DODGE.

Law and Labor.

IN the August number of THE ENGINEERING MAGAZINE Mr. R. S. Viktorov, stated on the title page to be a student of the subject, has given a cursory review of "Labor Legislation in England." The tone of the article is unmistakably unfavorable to such legislation; but no other remedy for the growing disabilities of the laboring classes is suggested. Of the two alternative avenues through which labor can seek relief from intolerable burdens,—peaceful law-making or revolutionary violence,—the author of the article under consideration does not indicate which is his choice. He contents himself with simply casting doubt upon the efficacy of the law-making power as a remedy for the real or fancied evils of which labor complains.

From this account of labor legislation in England it appears that non-enforcement of its provisions has been one of the causes of the failure to which Mr. Viktorov directs attention, and this failure to enforce law has largely resulted from impracticable features of the laws. But this sort of failure is not confined to labor legislation. It is equally pronounced in sanitary legislation, legislation for prevention of smuggling, laws for regulating sale of liquors and food, Sunday laws, etc. If more or less failure to enforce laws relating to any social condition which it may be desirable to promote or to suppress be a sufficient reason for abandoning legislation in such direction, what other resources are at command in dealing with prevalent and growing evils? Obviously either society must be abandoned to anarchy, or attempts, often unsuccessful but sometimes otherwise, must continue to be made through legislation to remedy evils that arise as civilization advances, and which spring from new inventions, new discoveries, and changes in habits of living, just as naturally as benefits. The cheap illumination furnished by petroleum oil has been accompanied by increased fire risk resulting from its general use as an illuminant. Certain dangers to life and limb now exist that were unknown prior to the adoption of electric propulsion for street railways. Not to multiply illustrations, this same sisterhood of good and evil may be found in any close scrutiny of the results of any important improvement.

What then! Must the benefits of all improvements be renounced because they also entail some evils? Should we not rather accept the benefit and strive by peaceful and orderly means to suppress, or, if this be impracticable, to regulate and minimize, the attendant evil?

Nothing is surer than that in legislation and social order the law of the survival of the fittest holds with as much force as in the development of species in the animal and vegetable kingdoms. To fail once, thrice, or even many times is often necessary to ultimate progress (social and economic science not excepted), for lessons of temporary failure are often not less valuable as pointing the way to truth than those of temporary success. If legislation be hopeless as a remedy for social evils, there is little hope for the future of civilization, and a strong probability that anarchical principles will bring about a revival of barbarism, out of which wreck it may require ages to again evolve a new civilization.

A. BARDOLF.

THE WORLD'S FAIR IN RETROSPECT

A SOUVENIR NUMBER OF

THE ENGINEERING MAGAZINE

SPECIALLY DESIGNED TO INDICATE THE PRACTICAL VALUE OF THE WORLD'S COLUMBIAN EXPOSITION TO THE SCIENCE AND INDUSTRY OF THE TIME

A BIRD'S EYE VIEW OF THE FAIR.

A VIEW OF THE FAIR FROM THE MIDWAY PLAISANCE.

THE ADMINISTRATION BUILDING.

THE COURT OF HONOR, FROM THE ADMINISTRATION BUILDING.

THE COURT OF HONOR, FROM THE PERISTYLE.

THE PERISTYLE AND THE STATUE OF "THE REPUBLIC."

THE COURT OF HONOR LOOKING FROM THE SOUTH.

THE MACMONNIES FOUNTAIN.

MANUFACTURES AND LIBERAL ARTS BUILDING.

INTERIOR VIEW OF THE LIBERAL ARTS BUILDING.

THE ELECTRICITY BUILDING.

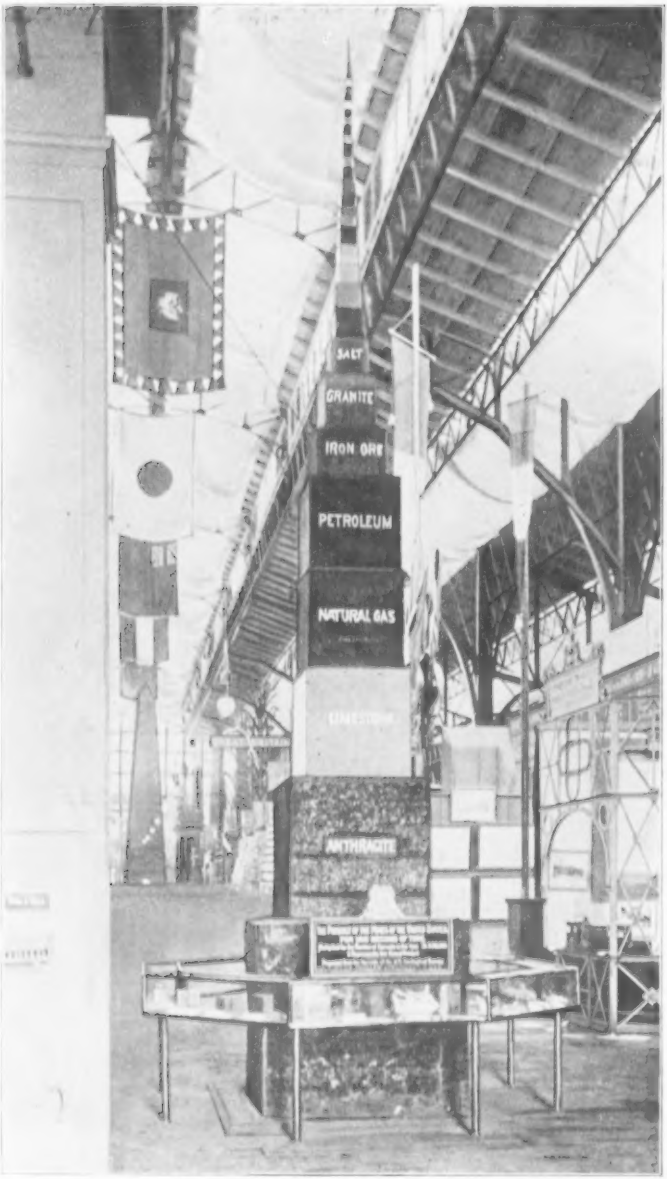
THE PALACE OF MECHANIC ARTS.

THE AGRICULTURAL BUILDING.

A VIEW IN THE AGRICULTURAL BUILDING.

THE MINING BUILDING.

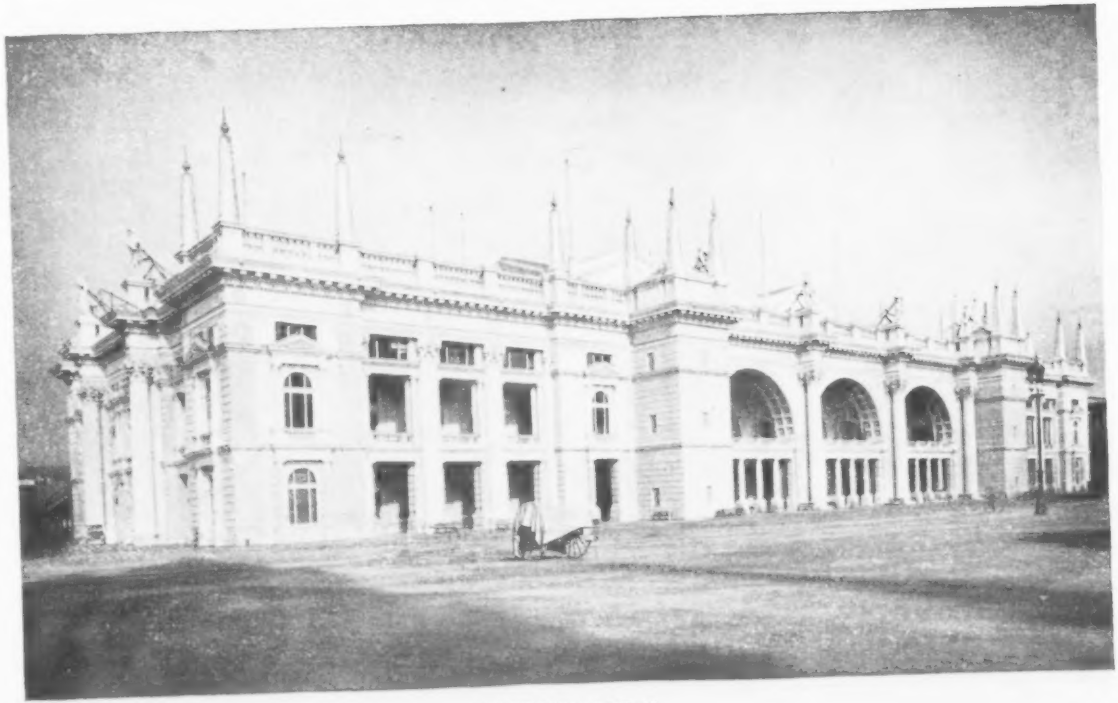
NEW SOUTH WALES EXHIBIT IN THE MINING BUILDING.



COLUMN ILLUSTRATING MINERAL PRODUCTION.

A VIEW IN THE MINING BUILDING.

THE MONTANA EXHIBIT IN THE MINING BUILDING.

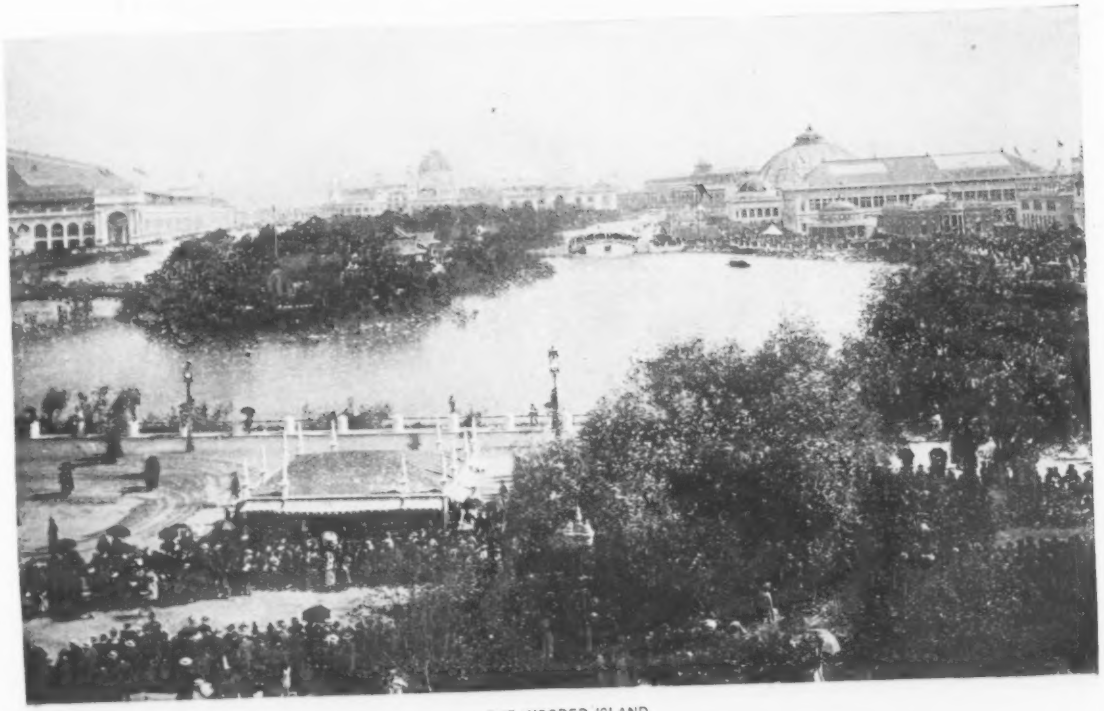


THE TERMINAL STATION.

LOADING AND UNLOADING ILLINOIS CENTRAL TRAINS AT THE FAIR.

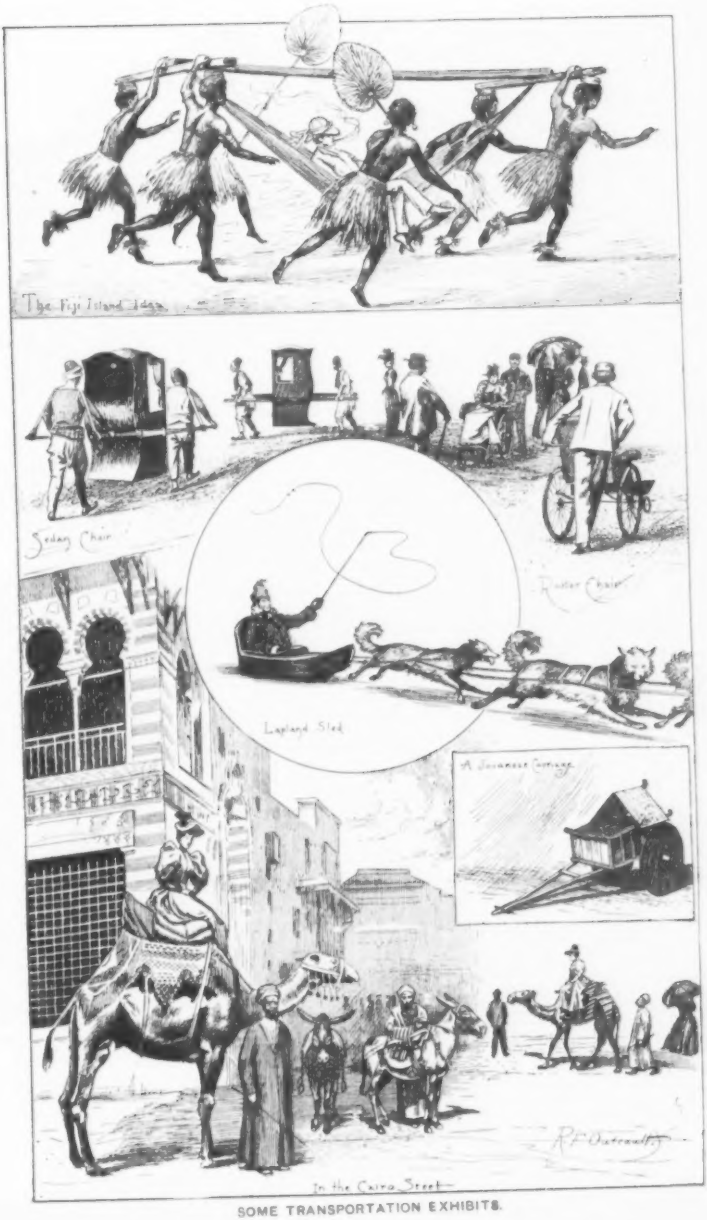
THE TRANSPORTATION BUILDING.

A VIEW IN THE TRANSPORTATION BUILDING.



THE WOODED ISLAND.

THE FINE ARTS BUILDING.

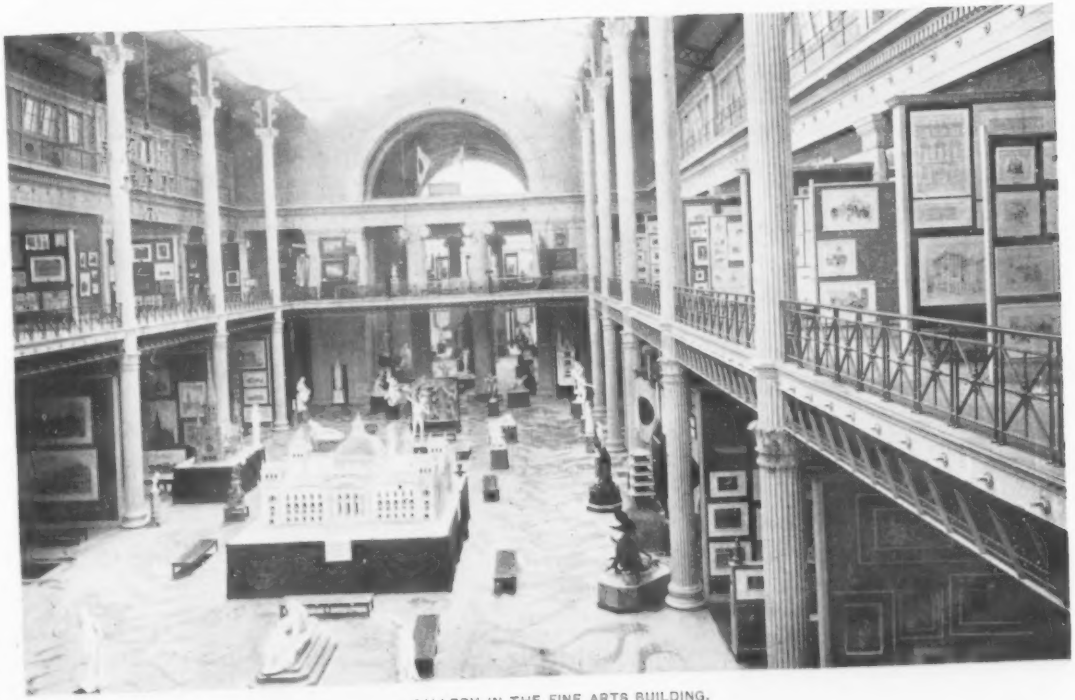


SOME TRANSPORTATION EXHIBITS.

THE HORTICULTURAL BUILDING.

THE FISHERIES BUILDING.

A VIEW IN THE FISHERIES BUILDING.



A GALLERY IN THE FINE ARTS BUILDING.

UNITED STATES GOVERNMENT BUILDING.